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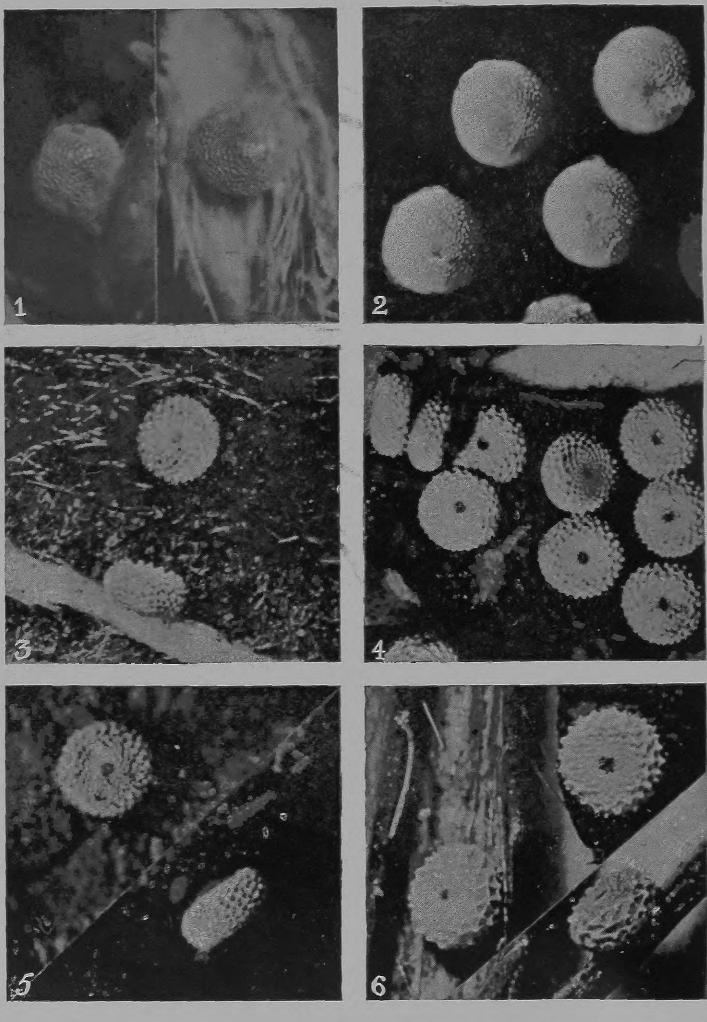
PLATE IV.




EGGS OF THESTORIDS AND POLYOMMATIDS.

*Natural History of British Butterflies*, January, 1906.

PLATE IV.

*(To be bound facing Plate IV.)*

EGGS OF RURALIDS.

FIG. 1.—CALLOPHRYS RUBI.
FIG. 2.—CALLOPHRYS RUBI.
FIG. 3.—ARICIA var. ARTAXERXES.
FIG. 4.—POLYOMMATUS ICARUS.
FIG. 5.—AGRIADES BELLARGUS.
FIG. 6.—AGRIADES CORYDON.

All ×20 diameters.

A NATURAL HISTORY OF THE

# BRITISH LEPIDOPTERA

*A TEXT-BOOK FOR STUDENTS AND COLLECTORS*

BY

J. W. TUTT, F.E.S.,

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## PREFACE.

In presenting this volume to my brother lepidopterists, some little explanation is necessary. Although it is essentially vol. viii of *The Natural History of the British Lepidoptera*, it has been appearing for a considerable time in parts as *A Natural History of the British Butterflies*. The real reason for publishing this volume out of its proper order was threefold—(1) The large amount of material on the group that had been slowly amassing during the last twenty years, and the increasing difficulty of dealing with it; (2) the fact that a really good scientific work on British butterflies was an undoubted desideratum among advanced workers; and (3) the long time which must necessarily elapse before the material to be dealt with in the two intermediate volumes. vi and vii, can possibly be worked out and prepared for publication; volume v is being cleared up for publication contemporaneously with this. It is trusted that these reasons will be considered sufficient to excuse my action.

It is exceedingly difficult to foretell the extent of detailed and exhaustive treatises of this character. When one is working at a group, one accumulates material from all possible sources, and such detail can only be finally estimated when the printer has set it in type, and one sees the actual printed matter before one. That I should only be able to treat of ten species in a large volume would, two years ago, have appeared to me absurd, and that an account of *Rumicia phlaeas* would extend to 84 pages, or 10 pages more than our account of *Manduca atropos* in vol. iv, would have been considered impossible, but, as one pieces all the facts together, one finds the accounts of some well-known species growing beyond all previously calculated dimensions, whilst, of others, one is astonished at the necessity of working out, almost *de novo*, the whole of the life-history, and the trouble attached to this is not to be despised. The practical completion of the life-histories of *Chrysophanus dispar*, *Thymelicus acteon*, *Urbicola comma*, etc., are the result of much painstaking and careful work on the part of my collaborators, and the detailed account of the world-wide variation of such species as *Rumicia phlaeas*, *Urbicola comma*, and *Cyclopides palaemon*, should bring home a recognition of the importance and bearings of a knowledge of species outside the narrow boundaries of our own islands.

If, in all the preceding volumes, I have happily had to acknowledge much generous help, in this my obligations have been increased tenfold. As usual, to Dr. T. A. Chapman and Mr. A. W. Bacot, first thanks are due, but in no smaller degree also to Mr. A. Sich, Mr. M. Gillmer, and Mr. S. Edwards; whilst no less am I indebted to Mr. F. Noad Clark, Mr. A. Tonge, and Mr. Hugh Main, to whose kindness I owe almost all the beautiful photographs by means of which the volume is illustrated. Mr. H. Rowland-Brown, too, has done yeoman service with regard to our distribution lists, and there are many more whom one ought certainly to mention—

Professor Blachier, Mr. A. W. Kappel, Mr. W. F. Kirby, Paymaster-in-Chief G. F. Mathew, Rev. G. H. Raynor, Mr. Raleigh S. Smallman, etc. It is impossible to mention all those to whom we are further indebted for incidental observations, notes, and lists of localities. I can only say that without their kind help the volume, as it now stands, could never have appeared. I may add that I have had no hesitation in writing for information to any lepidopterist, at home or abroad, who, I thought, might help me to clear up any point concerning any insect of which he might have special knowledge. In every case my queries have been most courteously answered. I trust that such will not mind if in the near future I have to worry them again. For the index we are largely indebted to the Rev. G. H. Raynor, who kindly responded to our request for help in this direction.

I sincerely trust that the result of the work expended on this volume will commend itself alike to field naturalists and scientific lepidopterists, and that it will meet with their approval. Information on the British species of Theclids and Lycænids is greatly desiderated, and any such will be most gratefully received. Our knowledge of some of the commonest species of "blues" is of the most scrappy character, and material to complete in detail our knowledge of their life-histories and habits is urgently needed. We shall be most thankful for any help in this direction.

# CONTENTS.

## Part I.



## Part II.

# BRITISH BUTTERFLIES.

## CHAPTER I.

### GENERAL OBSERVATIONS ON BUTTERFLIES.

Butterflies and moths together make up the order of insects known as Lepidoptera (scale-winged insects), so called because their wings are covered with delicate scales which are very easily removed. The popular idea is that there are profound differences between butterflies and moths, but this is not so, the butterflies comprising simply two of the superfamilies of the "upright-egged" stirps of the lepidoptera, and finding probably their closest relatives in the Castniids, Notodontids, Noctuids, etc.

There is, indeed, no real line of demarcation between butterflies and moths, those superfamilies of moths just mentioned being much nearer to the butterflies than to many other superfamilies of moths. The general characters that are supposed to distinguish butterflies are (1) The knobbed antennæ. (2) Resting with their wings upright, *i.e.*, with their wings raised vertically face to face over their bodies. (3) The thorax and abdomen being separated by a waist, etc. Some moths, however, have knobbed antennæ, others rest with their wings upright over their backs, and yet others have the waist between the thorax and abdomen more marked than in many butterflies. The fact is that all lepidoptera have been evolved from the same original stock, the various superfamilies having been produced by modifications and changes taking place through the course of ages, yet all, different as they now are, bearing the stamp of a common origin. The differences have no doubt been brought about by changes in environment, the individuals having to adapt themselves to the great physical changes that we know the earth and its atmosphere have undergone in past time.

Geological remains of insects are scarce, due no doubt to the fragile nature of the organisms themselves. Yet there is much fragmentary testimony of the history of insects written in those remains that have been found. Butterflies and moths are among the more recently evolved insects, and appear to have been contemporaneous with flowering plants, the newer rocks of the Tertiary period providing most fossil examples. Although above 30000 fossil insects have been found in the tertiary beds of Europe and America, only about 20 examples of lepidoptera have been found. Scudder notes that over 15000 fossil

insects have been found in the neighbourhood of the small lake of Florissant, high up in the Colorado Parks, yet he has only seen eight butterflies among them, each belonging to different genera. He further notes that this is also the case with the fossil butterflies found at Radoboj, at Aix, and at Rott in the European tertiaries, and with two exceptions, *Eugonia* and *Pontia*, no representative of genera found today has been discovered. The fossil species are all extinct.

It is largely a matter of speculation, from which of the main stirpes or root-stocks of the lepidoptera the butterflies have sprung, but they have, as we have already noticed, upright eggs in common with Castniids, Noctuids, etc., and the arrangement of the tubercles and the presence of the remarkable chinglands of their larvæ also suggest that these are among their nearest allies at the present time. The matter is just here of less importance than the knowledge that, since the butterflies branched off on their own account, they have developed, in various directions, strongly marked characters of their own, and that now, each of the two, usually-accepted, large superfamily groups, *Urbicolides* or Skippers and *Papilionides* or Papilios, is subdivided into large groups or families, some containing vast numbers of species exhibiting very varying degrees of specialisation.

Some butterflies are very generalised in their structure, *i.e.*, they show a number of very simple characters which are commonly observed among a large number of other lepidopterous insects, others again are exceedingly specialised and show some well-marked peculiarity very strongly. Of our two large groups the *Urbicolides* are assumed to be more generalised than the *Papilionides*, although, compared with many other superfamilies, the *Urbicolides* are very highly specialised.

Whilst, therefore, there are marked differences between the superfamilies and families into which butterflies are subdivided, it will be readily understood that they are, in reality, very closely allied to the moths. No hard and fast lines of distinction can be shown to exist; variation is the basis of all progress in evolution, and the student, therefore, must look for differences as well as similarities, and try to fathom the meaning of both when he observes them. Similarities in some one particular do not always denote close relationship between species, they may be mere analogies and not homologies, whilst marked differences do usually denote considerable separation and more distant relationship.

## CHAPTER II.

### EGGLAYING OF BUTTERFLIES.

The egglaying habits of butterflies are very varied, yet almost absolutely constant for the same species. So much is this so that, in many instances, the butterfly selects almost exactly the same portion of the plant on which to deposit her eggs, the upperside of a leaf, the underside of a leaf, the pedicel of a flower, the sheathing part of a grass blade, etc. Thus it has been noted (*Ent. Rec.*, iv., p. 225) that, whenever the ♀s of the early brood of *Cyaniris argiolus* choose holly on which to lay their eggs, they almost always lay them on the calyx,

and it is further observed how important this is to the insect, for should they lay them a fraction of an inch higher up, they would almost certainly be destroyed, as, when the buds once open, the petals are very easily blown away by the wind. Similarly it is noted (*op. cit.*, xii., p. 269) that, when the ♀s of the late brood of this species lay their eggs on the ivy-umbels, the base of the calyx is also almost always chosen. It is remarkable that, if the twigs are chosen instead of the flowers, the eggs are laid much more indiscriminately. In the same manner both the ♀s of the early brood of this species, and of *Callophrys rubi*, frequently choose *Rhamnus frangula*, and, when this is so, the base of the calyx appears again to be almost invariably chosen. Similarly, the eggs of *Nemeobius lucina* are laid on the undersides of primrose leaves, generally one on each leaf, but two, three, four or even five are sometimes to be found on the underside of the same leaf, possibly laid by different ♀s, but it is the underside and not the upperside of the leaf that is practically always chosen. As we propose giving a separate paragraph on the mode of egglaying of each of our British species in the systematic part of this work, there is no need to give a large number of examples here.

One of the most remarkable facts connected with the egglaying of butterflies is what may be termed the botanical instinct. Species whose larvæ are usually confined to one or two plants will sometimes, under the stress of necessity, select an introduced plant, and it is remarkable that, in most cases, this will be a plant closely allied botanically to its natural foods. The ♀ *Euchloë cardamines* chooses the base of the footstalk of a somewhat *passé* flower of *Cardamine pratensis* on which to lay its yellow egg. Failing this it will accept *Alliaria officinalis*, and other common *Cruciferae*, and, if it enters a kitchen-garden will utilise the flowers of horse-radish. Never by any chance does it select any plant unless it belongs to this natural order. Similarly the ♀s of *Gonepteryx rhamni* choose the underside of the leaf of a *Rhamnus* bush, laying the egg on one of the veins, and passing by all other plants in the hedge or woodside, however similar they may appear. This selection appears to be made by the sense of smell, and the accuracy with which the selection is made is sometimes very remarkable. Fritz Müller cites some curious instances in which butterflies appear to have recognised the affinities of certain plants before they had been discovered by botanists, *e.g.*, he says (*Nature*, xxx., p. 240): "The caterpillars of *Mechanitis*, *Dircenna*, *Ceratinia* and *Ithomia*, feed on different species of solanaceous plants (*Solanum*, *Cyphomandra*, *Bassovia*, *Cestrum*), those of the allied genus *Thyridia* on *Brunfelsia*. Now this latter genus of plants had been placed unanimously by botanists among the *Scrophulariaceae*, until, quite recently, it was transferred by Bentham and Hooker to the *Solanaceae*. It thus appears that butterflies recognised the true affinity of *Brunfelsia* long before botanists did so. Another and more curious instance of butterflies confirming the arrangement of plants in the *Genera Plantarum* is exemplified by *Ageronia* and *Didonis*, which were formerly widely separated by lepidopterists, being even considered as belonging to distinct families, but now placed near each other in the Nymphalids, the larvæ leaving no doubt of their close affinity. The larvæ of *Ageronia* feed on *Dalechampia*, those of *Didonis* on *Tragia*. These two euphorbiaceous genera were widely separated by Endlicher, who placed

the former among the *Euphorbiaceae*, the latter among the *Acalyphaceae*, Bentham and Hooker, on the contrary, place them close together in the *Plukenetieae*, so that their close affinity which had been duly appreciated by butterflies has finally been recognised by botanists also."

Another remarkable fact connected with this subject is the narrow range of plants from which some species have to select and the wide range of others. *Aglais urticae* is confined to stinging-nettle, *Limenitis sibylla* to honeysuckle, yet *Polygonia c-album* has foodplants as widely different as stinging-nettle, black-currant and hop, and *Pyrameis cardui* as stinging-nettle, thistle, mallow and bugloss. Still, on the whole, our butterflies have a very small range of foodplants compared with that of many moths, some of which appear to be more or less polyphagous, *e.g.*, *Saturnia pavonia* (*Brit. Lep.*, iii., p. 333), *Manduca atropos* (*op. cit.*, iv., pp. 432-3). In America, however, Scudder notes that the "swallow-tail," *Jasoniades glaucus*, feeds upon plants belonging to no fewer than 15 different families. Not only is the range of plants which a species chooses as food for its larvæ very restricted, but there is usually a very close alliance between the plants selected by the ♀s of all the species of the same family, *e.g.*, all the European Urbicolid skippers choose grasses and rushes of various kinds, the Hesperiid skippers on the other hand have a much wider range among *Malvaceae*, *Rosaceae*, *Leguminoseae*, etc.; the Chrysophanids prefer plants belonging to *Polygonaceae*, the Lycænids and Coliads choose *Leguminoseae*, the Argynnids use *Violaceae*, the Pierids *Cruciferae*, the Cœnonymphids, Satyrids and Erebiids, grasses, and so on. It will be known to most lepidopterists that these general statements are largely true of butterflies belonging to these groups throughout the whole of the Palæarctic and Nearctic regions.

We have already noted that the egglaying habit of butterflies is usually constant and fixed even to the extent of considerable detail. Almost all butterflies lay their eggs definitely on their foodplant, the only British species which appears not to do so being *Melanargia galathea*, which drops its eggs loosely among the roots of the grasses on which the larvæ live. Occasionally a ♀ of a species with a fairly constant egglaying habit appears to blunder and will choose a dead stem of grass or other object in the immediate neighbourhood of the foodplant, but the occasions on which this happens are rare, and the choice of the foodplant and the selection of an exact position in so many cases are instinctive processes which have been brought to a high stage of perfection in the development of the race. *Chrysophanus virgaureae* chooses a dead or dying stem on which to lay its hybernating egg. The choice of the foodplant, as we have already noted, is almost certainly effected by means of scent. The antennal sensory organs (among which those of scent are included) have been worked out in detail (*Ent. Record*, viii., pp. 225, 261). We know that the sense of vision is exceedingly limited in butterflies, and experiment is against the assumption that they use their power of sight for any such delicate discrimination as is required when they are selecting a special species of foodplant on which to lay their eggs. On the other hand, their movements, when on this important business, are such that it would seem obvious that they are seeking by scent the plants on which to lay. A ♀ will often settle on a dozen different plants similar and dissimilar to that wanted before she finds the right one on which to

lay her eggs. On the other hand, some will fly rapidly from plant to plant when on egglaying intent without much delay, and especially is this the case where the species is local and the foodplant abundant, *e.g.*, *Polyommatus bellargus*, etc.

## CHAPTER III.

### EGGS OF BUTTERFLIES.

Lepidoptera are holometabolic insects, *i.e.*, they are insects that have a complete metamorphosis, assuming in turn, the egg, larval, pupal and imaginal stages. The eggs of butterflies are naturally of small size, and photographing them has added much charm to the description of these beautiful objects. Under an ordinary lens much of their remarkable beauty may be discovered, but for a proper appreciation of their lovely forms, delicate sculpturing and detailed structure, a good microscope is necessary. The egg itself is a cell, consisting of an outside shell, enclosing the living protoplasm which is, at first, homogeneous; the shell is a thin, elastic pellicle, often transparent, and, when opaque, usually made so by the ribs that longitudinally and transversely cross its surface, although, in some cases, as in some of the Urbicolids, etc., there is a general thickening of the wall. The butterfly egg is of the "upright" type, *i.e.*, it has its micropylar axis perpendicular to the surface on which it is laid, whilst its transverse section (at right angles to the micropylar axis) almost always forms a circle (the only exceptions known being those of the Thymelicids), and its base is almost always flattened at the point of attachment. At the apex or point opposite the base, a number of microscopic canals lead into the interior of the egg; these canals are surrounded by a rosette of tiny cells, the whole structure being termed the micropyle. Through these little canals the spermatozoa pass to fertilise the egg.

In all the species of any given family, the eggs are almost always very similar, although the details vary in each species. The Thymelicid eggs are "flat" in outline, with three axes of different lengths, whilst all other butterfly eggs have a horizontal section that is circular; the Urbicolid (*sens. rest.*) skipper eggs are somewhat more than hemispherical, those of the Lycænids are shallow, flattened, tiarate or echinoid in shape, those of the Papilionids and some Satyrids almost globular, of the Pierids, long, slender and spindle-shaped, of the Nymphalids somewhat barrel-shaped, with projecting ribs reaching from apex to base, of most of the Satyrids cylindrical or spheroidal, etc. The barrel-shaped egg is sometimes more or less conical, and it is usually rather broader at the base than at the summit. The surface of the egg may be practically smooth, reticulated with a surface sculpture, or ribbed longitudinally from base to apex, and often with finer transverse ribs running round and crossing the longitudinal ones. These various modes of sculpture run into one another, and are often not sharply defined, and in the Lycænid and Limenitid eggs the sculpture forms patterns and traceries of exquisite beauty. The ribbing generally fades off into the micropylar area,

usually a slight depression surrounding the micropyle proper, of which mention has already been made. It may be well here to remark that whilst the Urbicolid (Pamphilid) group of skippers tends to smooth eggs, forming rather more than a hemisphere, those of the Hesperiid group are hemispherical, with well-defined, clearly-cut, strongly projecting longitudinal ribs, which give them an appearance much more resembling that of the eggs of Argynnids than the other skippers. We have already noted that, in the same group, the Thymelicids have flat eggs, superficially like those of many moths, except that the micropylar axis is upright. The number of ribs running from the base to the apex varies considerably, in the Vanessids they may be reduced to eight, and rarely have more than twelve, in the Coliads there may be as many as thirty or forty.

The eggs of butterflies are usually of a pale yellow or pale greenish colour when first laid, but those with transparent shells change their colour very rapidly, the tint becoming quickly that which will best preserve each in the position in which it is laid. It is usually placed on a leaf, and then hatches in a few days, but if the eggstage lasts for any length of time, the position chosen is on a twig or other permanent part of the plant. The egg of *Euchloë cardamines* is pale yellow when laid, becomes deep orange in about twenty-four hours; and remains of this tint till just before the larva hatches, when the embryo can be seen coiled up within the transparent eggshell. Other eggs change from yellow to pink, or brown, or pale salmon, and then to greyish in different species. As the young larvæ mature within the egg, there is a considerable change observable inside in those of many species, due to the development of the embryo within. These changes can, in some of the more transparent-shelled species, be readily traced under a microscope, *e.g.*, *Pararge megaera*, *Nemeobius lucina*, etc. Those British butterflies whose eggs go through the winter are few in number, *viz.*, *Argynnis adippe*, *Thecla w-album*, *T. pruni*, *Zephyrus betulae*, *Z. quercûs*, *Urbicola comma*, *Adopaea lineola* and *Thymelicus acteon*. The hybernating stage of *Lampides boetica* is very uncertain. The old myth of the eggs of *Aporia crataegi* (*teste* Rennie and other authors) going over three winters and then hatching, is absurd.

The eggs of butterflies are usually laid singly, rarely more than two or three on a leaf, but a few British species, *e.g.*, *Aporia crataegi*, *Pieris brassicae*, *Melitaea cinxia*, *M. athalia*, *M. aurinia*, *Vanessa io*, *Aglais urticae*, *Eugonia polychloros*, and *Euvanessa antiopa*, and many of their Continental and exotic allies, lay their eggs in clusters, either as regular rows or irregular heaps, on a twig or the upper- or underside of a leaf. Some of the Polygonias lay their eggs upon each other in a string, as it were, from three to ten eggs in a single file.

Eggs are subject to many dangers after being laid. A particular group of Hymenoptera, called Chalcids, lay their eggs inside the eggs of lepidopterous insects, and find within them sufficient nutriment to come to perfection; in fact, a dozen or more perfect Proctotrupids sometimes emerge from a single moderate-sized egg, having passed their entire existence within, and obtained the whole of their nutriment from the contents of, this tiny receptacle.

It has already been noted that the egg consists of an outside shell and its protoplasmic contents. After fertilisation, the time varying much with the species, the contents begin to thicken visibly and to

undergo development, which can, in some species, be readily observed through a microscope. The first cells formed unite together, and present some parts darker than others, and after a time the fluid mass breaks away from the eggshell, and a tubular structure, which soon becomes deeply segmented, forms within. The rings become distinct, and those which form the head (apparently four in number) are at this time much larger than the others. As development proceeds these get welded together, and the hard mouthparts become visible. At the same time the three segments forming the thorax have little cells developed on their outside. These are the rudiments of the legs. Then a great change takes place in the position of the embryo whose development has thus far been traced.

Up to this point, the embryo has been lying in a somewhat circular form with the legs outside, *i.e.*, towards the eggshell, but now it gradually changes its position until the body is somewhat S-shaped, the movement continuing until a complete reversal has taken place and the embryo has returned once more to a circular position, but with the legs now pointing towards the centre of the egg. At this time, distinct patches appear on the cheeks, and gradually six black spots develop on each dark patch. These are the ocelli, five of which are arranged in lunular form, the sixth being isolated and at some little distance from the concave side of the others. The ocelli are simple lenses, and very different from the complicated structure of the compound eye of the imago.

During the time that this has been going on, structural changes have been taking place inside the embryo. A hollow sac forms along the back, and after a time this keeps up a regular pulsation. This is the dorsal vessel, and the centre of the circulatory (blood) system. The alimentary canal also becomes traceable, and possibly, whilst you are watching, you may observe tiny silvery threads suddenly come into view, which look as if they traverse the larva in all directions; this appearance is due to the sudden expansion of the air-vessels which, as we can now see, start from the little spiracles along the sides of the body, this respiratory (air) system having been invisible hitherto because of their transparency. After this, little lines gradually appear, crossing the embryo in different directions, and usually traceable to little chitinous buttons from which they arise; these are the hairs or primary setæ. Certain marks on the embryo also become distinct, and other peculiarities may possibly be noticed. At last the embryo is not noticed to undergo any further change; its jaws are seen to move steadily to and fro against a particular part of the eggshell, usually at or very near the micropyle, until a little hole is made in it, the edge of which the contained larva continues to nibble until it can squeeze its body through the aperture.

It is well to remember that in some of the hybernating eggs the larva is formed in the early autumn, and remains all the winter in the egg, hatching only with the spring, *e.g.*, the egg of *Argynnis adippe*, laid in July, has its embryo fully developed in less than a month, but does not hatch until the following March, the egg of *Adopaea lineola*, and possibly others, is in similar case.

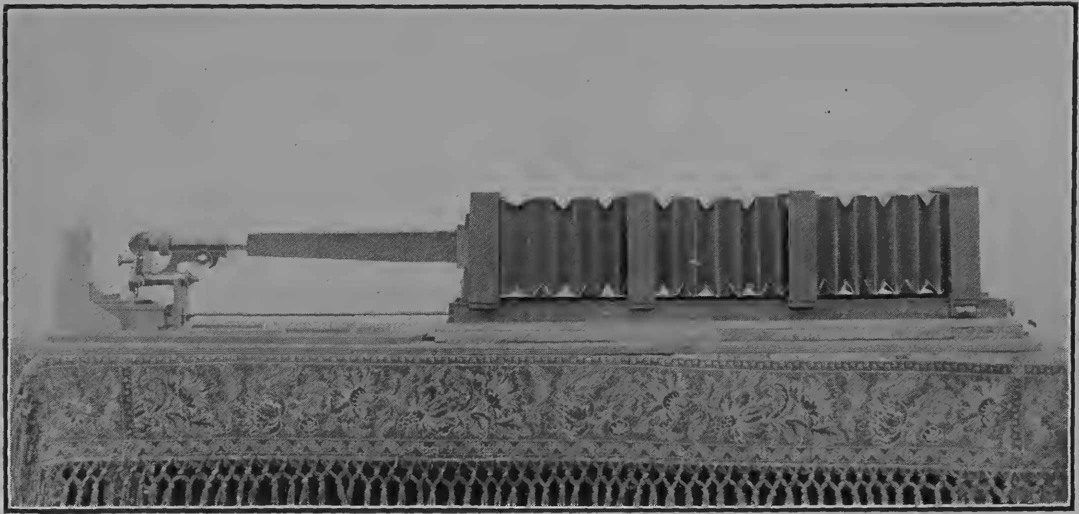
## CHAPTER IV.

### PHOTOGRAPHING BUTTERFLY EGGS.*

My first attempts at photographing ova were made with an ordinary ½-plate stand camera, focussing from the *back*, attached to a student's microscope, and with this I was able to obtain results which surprised me, but was handicapped by the short extension obtainable with the camera (about 15in.), as this necessitated using the eyepiece of the microscope to bring the image to a focus at a point nearer the objective than would otherwise be necessary. This caused some loss in definition, and I also had considerable difficulty in getting an objective of long enough focus to cover the whole of a small batch of ova and at the same time admit of the object being focussed with the eyepiece I possessed. Having obtained a 3in. objective which filled these necessary requirements, the next step was to construct a base board on which to fix the camera and microscope in proper alignment. For this purpose I used a smooth deal board about 3ft. long, 6in. wide, and 1in. thick, and ruled a straight line down the centre from end to end as a guide to obtaining a proper alignment of the completed apparatus. On placing the camera and microscope upon it, with the body tube of the latter lowered to a horizontal position, I found that the line of projection was considerably below the lens aperture in the camera front, so the next step was to construct a block for the microscope to stand upon, which would raise it sufficiently to bring the eyepiece exactly in the centre of the lens aperture, and permit of an imaginary line being drawn horizontally from the centre of the objective to the centre of the focussing screen of the camera, and pass centrally through the intervening portions of the microscope body and the camera. This block I screwed down firmly in the required position, and fixed small wooden stops at the sides and ends to prevent the microscope from slipping when placed on it.

I then drilled a hole for the camera screw in the centre of the base board, in such a position that, when the camera was screwed down to it, the lens front just touched the eyepiece of the microscope, when the latter was racked out to its fullest extent. It was now necessary to devise some means of connecting the microscope with the camera in such a way as to exclude all light except that passing through the former, and yet to admit of focussing being done as usual. To do this I obtained from an instrument maker a short brass tube about 1in. in length, with a screw thread cut on one end to fit the lens flange of the camera. This I screwed in, in place of a lens, and then made a sleeve of black velvet to slip over it, long enough to be drawn over the microscope body tube, and held in place at either end with an elastic band. This answered admirably, and I found that after focussing an object on the stage of the microscope and then connecting the microscope with the camera, I was able to get a sharp image on the ground glass of the latter with the extension at my disposal, and to reduce or enlarge this by altering the amount of camera extension, and then to refocus with the microscope by stretching

* This chapter is by Mr. A. E. Tonge, who is doing the photographs by which this book is illustrated.



Apparatus for Photographing the Eggs of Butterflies.

*Natural History of British Butterflies*, November, 1905.

out my arm along the side of the camera while I kept my eyes fixed on the focussing screen.

This somewhat primitive apparatus answered well so far as it went, but I soon determined to work without the microscopic eyepiece, and set to work, therefore, to build a very long extension camera. I made it ½-plate size, so that the accessories I already possessed could be used, and gave it a bellows 42in. long in three sections to obviate sagging. I found this was a great improvement, but had, of course, to get a much larger base-board, and used for this an oak plank 5ft. × 8in. × 1in. The focussing of the microscope could not now be done by hand, as the distance from the ground glass was too great for my arm, so I carried a long brass rod through wooden blocks under the camera, and fitted a small grooved pulley-wheel on it just under the fine adjustment screw of the microscope, and put a milled screw on the other end under the focussing screen of the camera. A fine elastic band passed round the pulley-wheel, and the fine adjustment screw then enabled me to focus comfortably, with my head under the black cloth, by turning the milled screw already mentioned. As the microscopic objective had to be brought very considerably closer to the object in order to throw a sharp image on the focussing screen than when focussed with the eyepiece in the microscope alone, I noted from experiment the amount of this variation by measurement, and screwed down the coarse adjustment of the microscope the necessary amount before connecting it with the camera, and, in this way, left only the final focussing to be done with the apparatus described above.

This answered much better and gave me many very excellent results, but I was still not satisfied, as I found that, unless the ova I wanted to take were small or had a comparatively flat upper surface, only a portion of the resulting picture came out sharp, and all the rest was out of focus, owing to the lack of penetration in the microscopic objective. To improve this, I adapted a rapid rectilinear photographic lens of 5in. focus to fit the body tube of the microscope in the place of the usual objective, and, as this rendered the stage useless for holding the object to be photographed, and the distance obtainable between it and the lens was much too short for a lens of so long focus, I took advantage of the circular opening in the stage to work through, and fixed up a movable slide carrier in proper alignment working behind the supporting block on which the microscope stood. This was a great advance, but I was not, of course, able to get so large a magnification as with the microscope objective, as, even with the aid of a special extension which I fixed up between the camera lens front and the microscope body tube, which enabled me to obtain a maximum extension of 5ft. between the focussing screen and the lens, I could only get a magnification of about ten diameters, while the exposure required was nearly double. On the other hand, I had the advantage of an iris diaphragm in the lens, so that I could focus with this open to the fullest extent and admitting the maximum amount of light, and then stop down to f. 16 or f. 22 for the exposure, and in this way get the whole of the largest butterfly ova including even the background.

A very powerful illuminant is an absolute necessity for this kind of work. I started with a paraffin lamp, but soon found this useless, not only on account of the amount of heat it gave out, but also owing

to the lack of contrast obtainable in the illumination, and particularly to the very great difficulty in focussing accurately when the ground glass image was so faintly lighted. Fortunately I was able to avail myself of an electric light installation, and found a ·25 Amp. Nernz lamp admirable in every way, as it gave a 25 to 30 candle-power light, and this, with a single condenser on one side of the object and a mirror reflector on the other to reduce the blackness of the shadows it made, appeared as nearly ideal as I could imagine. I have not tried incandescent gas myself, but I understand from friends who use it that it gives equally good results. Still I should imagine that the heat trouble would obtrude itself, especially if the light were placed near to the object, whereas, with the Nernz lamp, the light can be approached to within 3in. of the ovum being operated on, without any untoward results. The great points to bear in mind are to get a brilliant illumination of the object from one side, and a somewhat less powerful lighting on the other, so as to show up the structure and rotundity of the ovum by contrast. The final critical focussing is best accomplished with the aid of a focussing magnifier held against the ground glass focussing screen, and fixing the attention on some brightly illuminated spot on the surface of one of the ova to be photographed.

After focussing and placing the sensitive plate in position, it is only necessary to cover the lens with a piece of black card while drawing out the flap of the dark slide, as any small amount of indirect side light entering the lens is quite negligible, and the card is more conveniently manipulated than a lens cap. The exposure necessary will naturally vary with the brilliancy of the illumination and the colour of the ova, but there is a large amount of latitude permissible with most of the dry plates on the market. I use the most rapid isochromatic plates I can obtain, always backed to minimise halation, and find that, with the 3in. microscopic lens and a magnification of twenty diameters, an exposure of two and a half to four minutes, according to the colour of the ova, is about right. With the 5in. Rapid Rectilinear, stop f. 16, magnification ten diameters, and similar illumination, I should give from four to seven minutes, but these exposures might be doubled without detriment to the resulting negative by a slight addition of bromide of potassium to the developing solution.

For holding ova in position while being photographed I use ordinary glass slips 3in. × 1in., such as are used for mounting microscopic slides. Ova *in sitú* on bark, portion of leaves, paper, etc., are easily fixed with a small dab of adhesive material, and, where needed, a background of suitably toned paper can be gummed on the glass slip first, and then the support for the ova fixed upon it. When the ova are loose, and particularly if it be desired to retain them uninjured for subsequent hatching, I find a most suitable method of mounting to be as follows:—Cut out a small square of gummed paper, say $\frac{3}{4}$in. each way, and punch out a circular hole in the centre $\frac{1}{4}$in. in diameter. An ordinary cork boring drill does this admirably. Then cut another smaller square of paper, tinted to suit the ova in question, and gummed on one side. This should be a little larger than the hole alluded to above, say $\frac{5}{16}$in. square. Place the small square, gummed side *upwards*, in the centre of the glass slip, moisten the gum

of the larger square, and press it down upon the smaller, so that the hole is entirely filled up, and all is held firmly to the glass slip. Now moisten a fine hair pencil between the lips and pick up a single ovum on the point of it. Breathe upon the prepared gum surface within the $\frac{1}{4}$in. hole, and place the ovum lightly upon it. Continue the process with as many ova as you wish to photograph at once, and they will all be found to adhere quite as firmly as is necessary for the purpose in hand, while they can be easily brushed off afterwards, and will be none the worse for the treatment they have undergone. At least one ovum of each species should be mounted upon its side, and it will then be available afterwards to afford measurements otherwise unobtainable from the resulting photograph.

It is a very good plan to line the box, in which living ♀s are put for the purpose of obtaining ova, with paper, as then the ova will be laid in most cases on the paper, and are easily accessible, whereas, if they are laid directly on the sides of the box, these must either be cut up or a thin shave taken from them to obtain the ova uninjured.

The very worst material I know for photographic purposes on which ova can be laid is cotton wool. Each individual ovum must be separated from every strand of the wool before it can be mounted with any hope of getting it to lie flat, or of placing the entire batch as nearly as possible in one plane (a most *important* point to remember, or your photograph cannot be in focus all over), while every strand of the cotton which *does* get mounted with the ova, and there are sure to be some, comes out like a piece of rope, and quite spoils the picture. It is only necessary to try to manipulate ova so laid *once*, and you will thereafter be very careful to ask all your friends, when sending you any, to avoid getting them laid on cotton wool as they would avoid the plague.

It is unnecessary to go into any detail as to methods of developing the negative after it has been taken, as these will vary with the make of plate and the particular developer used, and are easily obtained from the manufacturers; but it is helpful to keep a full note with each exposure of at least the name of species, magnification, lighting, make of plate, exposure given, developer used, and colour and appearance of the ovum. I write these particulars upon the outside of a paper envelope, into which I afterwards slip the finished negative, before storing it away, and I *always* pencil the name of the species upon the corner of the plate before development, so that if it gets separated from its proper envelope at any future time it can be identified with certainty. The envelopes alluded to above should each bear a consecutive number, and, if an alphabetical index to these is compiled as they are made, any particular species required in future can be found without loss of time.

The exact amount of magnification is important, and once a convenient size has been fixed on, that, or multiples of it, should be strictly adhered to, as otherwise any comparison will be difficult. An easy method of ascertaining the magnification is to photograph a finely ruled scale in place of the ova, and then compare your negative with the original scale.

## CHAPTER V.

### OBTAINING EGGS OF BUTTERFLIES.

The student of the eggs of butterflies, be he biologist, field-naturalist, or photographer, will undoubtedly attempt to collect or otherwise obtain the eggs required for study. The best modes of obtaining these in confinement, and the best means of surmounting the difficulties that occur, are, perhaps, rather out of place in a work of this kind, and have already been dealt with fully elsewhere (*Practical Hints for the Field Lepidopterist*). A few hints, however, as to the best methods of obtaining the eggs of some of the species will, perhaps, not be so out of place, especially as the systematic portion of this work will take some considerable time in publication. The following hints are arranged under the headings of the various months in a manner likely to be followed by the field-naturalist, and in the order requiring attention.

January-April.—Eggs of *Zephyrus quercûs* on oak, *Thecla w-album* on elm, *T. pruni* and *Ruralis betulae* on sloe, are all placed as a rule near leaf-buds on twigs, and hatch towards the end of April.

Eggs of *Plebeius aegon* (*argus*) pass the winter in this stage; towards the end of February a sharp eye should be kept on them, as they always hatch in the last few days of February or the commencement of March.

Females of *Polygonia c-album* captured in late March and early April will lay freely on hop, currant and nettle, if carefully sleeved on plants that obtain a fair amount of sunshine.

Hybernated *Eugonia polychloros* taken in the spring should be retained for eggs; both sexes should be sleeved together for the purpose, as the earliest caught ♀ s after hybernation are rarely fertilised. Sallow is one of the best plants for the purpose of sleeving, and if the captives be fed with syrup, soaked into pieces of bark, they will lay freely.

When a ♀ *Gonepteryx rhamni* is observed flying by a hedgeside or on the outskirts of a wood, watch it until it selects a *Rhamnus* bush for egglaying; collect carefully the leaves and shoots afterwards; you will readily find the spindle-shaped eggs on the leaves and petioles. The underside of a leaf, the twig itself, or a terminal bud, is usually chosen, although the upperside of a leaf is not despised.

At the end of April and in early May the eggs of *Cyaniris argiolus* are laid singly on the underside of the calyx of holly-buds, so that, when the flowers open, the sepals fold over the egg, hiding it altogether from sight; the eggstage lasts about ten days. The eggs are also laid on the footstalks of flowers of *Rhamnus frangula*, and also on the young leaves of ivy.

May and June.—The pale greenish eggs of *Nisoniades tages* are laid on the leaflets of *Lotus corniculatus* from the end of May to the middle of June, the eggstage lasting about a fortnight.

Females of *Augiades sylvanus* will lay their eggs in confinement in late June, on cock's foot grass, if they be enclosed under a leno cover and placed in the sun. Similarly, females of *Cyclopides palaemon* may be enclosed over a plant of *Brachypodium sylvaticum*.

The circular, flattened, greenish-drab eggs of *Polyommatus astrarche*

are laid in June, in little groups of two, three, or more, on the underside of the leaves of *Helianthemum vulgare.*

In June, by following up a female *Polyommatus bellargus* when on egglaying intent, one can obtain eggs quite freely by picking the leaves one after the other as she quits the plants on which she has been engaged.

The egg of *Lycaena arion* is deposited in June among the flowers of *Thymus serpyllum*, being circular in outline, and covered all over, except a central depressed spot on top, with fine raised irregular reticulation, which, in profile, stands out strongly.

Pick the flower-heads of *Anthyllis vulneraria* in June for the eggs of *Cupido minima;* although they are placed low down on the calyces of the *Anthyllis* flowers, and thus hidden from casual observation, they may be easily detected on careful search. Females enclosed over a plant of *Anthyllis vulneraria*, and allowed plenty of sun, will lay eggs freely among the flowers.

The eggs of *Nemeobius lucina* are readily found on the underside of cowslip leaves in late May and June, not more than four or five on a leaf; also to be found similarly on primrose leaves. They may also be readily obtained by enclosing caught ♀s on potted plants of cowslip or primrose.

The eggs of *Melitaea aurinia* can be obtained freely by enclosing caught females in a leno sleeve over a plant of *Scabiosa succisa*, the eggs being laid in heaps on the surface of the leaves. In nature, the egg-batches may be found by careful searching and turning over the scabious leaves in their haunts.

Captured ♀s of *Brenthis euphrosyne*, taken in late May or early June, lay their eggs freely on the leaves of *Viola canina.* So also do those of *B. selene*, choosing indiscriminately the upper- and underside of leaves and the stems.

The imagines of *Melampias epiphron* will lay their eggs in confinement, if placed in a suitable receptacle with a supply of grasses on which the larvæ will feed, *e.g.*, *Nardus stricta*, *Aira flexuosa*, etc.

In late June (and during July) the beautiful eggs of *Limenitis sibylla*, covered with deeply-set hexagonal basins, and sharp prominent spiny points, giving rise to fine gossamer-like hairs, are laid on the edge of the underside of a honeysuckle leaf.

Eggs of *Colias edusa* may be obtained in June by placing a ♀ under a bell-glass with a sod of white clover; they are laid on the upper surface of the leaves; the eggs in a batch often hatch irregularly, even when the whole is deposited within a few hours. The ♀s should be supplied with a little honey and water for food, and will lay their eggs pretty freely so long as the weather is bright and sunny; during dull weather the butterflies will not lay.

Immigrant females of *Pontia daplidice* lay their eggs occasionally in June, on *Reseda luteola.*

In May, the flowering stems of *Cardamine pratensis* and *Alliaria officinalis* should be collected for the orange-coloured (yellow when first laid) eggs of *Euchloë cardamines*, which are usually laid (one on each flower-head) on the pedicel of a flower nearly over.

The long spindle-shaped eggs of *Leptidia sinapis* are to be found readily in May on *Vicia cracca* and *Lathyrus tuberosus.*

The globular, greenish-yellow or greenish-white (when newly-laid)

eggs of *Papilio machaon* are to be found, in early June and on through the month (often, indeed, until August), laid usually on *Peucedanum palustre*, in its local haunts in Cambridge and Norfolk.

JULY-SEPTEMBER.—The eggs of many species of butterflies may be obtained in July, *e.g.*, that of *Limenitis sibylla* (a most beautiful microscopic object) on honeysuckle; *Apatura iris* on sallow, etc. (We have seen a dozen of the latter collected in a single morning by watching a ♀, in a place where larvæ could never be beaten owing to the density of the vegetation).

The eggs of *Urbicola comma*, laid in August, on grass, do not hatch until the following March. Similarly, those of *Adopaea lineola* and ? *Thymelicus acteon*, laid in July. As most of the "skippers" hybernate as larvæ, care must be taken to look after the eggs of these species, and not throw them away with the idea that they are infertile.

The eggs of *Plebeius aegon* are laid in July on *Ornithopus perpusillus*, etc., but do not hatch until the early part of the following March.

The circular, flattened, greenish-drab eggs of *Polyommatus astrarche* are laid in August and September, in little groups of two, three, or more, on the underside of the leaves of *Helianthemum vulgare.*

Eggs of *Cyaniris argiolus* are laid in August, sometimes beneath the flower-heads of the umbels of ivy; the young larvæ then feed on tender ivy-leaves and flowers. They are at other times laid on the flower-stalks of holly, then the young larvæ burrow in the unexpanded buds.

Worn ♀s of *Thecla w-album* will oviposit freely if sleeved out in the sun on elm, in the early part of July. In nature, they are to be found above or directly below an aborted leaf-bud, and harmonise so exactly with the colour of the bark of the elm-twig on which they are placed that they are only to be detected with the utmost difficulty.

The yellowish milk-white eggs of *Zephyrus quercûs*, covered with a rough raised reticulation, are laid upon oak-twigs, where they may be found during the winter months. In spite of its colour, the egg is not at all easy to see, looking like a small, inconspicuous fungoid growth; after the maturation of the embryo it grows somewhat darker.

The females of *Coenonympha tiphon* will lay their eggs in confinement, if placed in a suitable receptacle, and exposed to the sun, with a supply of their foodplant, the beaked rush (*Rhyncospora alba*); this should be potted, and the young larvæ will feed thereon until their hybernating stage with little trouble.

Females of *Erebia aethiops* will lay their eggs quite freely in August, if supplied with grasses in a suitable receptacle, and placed in the light and sun; the eggs are glued to the culms of *Aira praecox*, *A. caespitosa*, etc., and are large and conspicuous. The young larvæ appear in about three weeks.

The females of *Epinephele tithonus* will lay their eggs fairly freely in confinement on *Poa annua*, *Dactylis glomerata*, and other common grasses; they hatch in about three weeks, and the young larvæ hybernate when exceedingly small.

The females of *Melanargia galathea* give their eggs perhaps more freely than any other butterfly; they are unattached, hatch in August, the young larvæ feeding well on common grasses.

The eggs of *Argynnis adippe* are laid in July and August on the leaves of *Viola canina*, generally on the underside or on the stems.

They change colour very rapidly as the embryos mature, but the larvæ do not appear till late February or early March the following year.

The eggs of *Dryas paphia* are laid in July and August; the egg-stage, however, only lasts about a fortnight, although the larvæ feed very little (or not at all) on *Viola canina* before hybernation.

Autumnal females of *Colias edusa*, enclosed on a growing plant of *Trifolium repens*, *Lotus corniculatus*, etc., placed in the sun, and supplied with a little honey and water for food, will lay their eggs pretty freely so long as the weather is bright and sunny.

Captured females of *Colias hyale* will lay their eggs on *Trifolium repens*, *Medicago lupulina*, *M. sativa*, etc., in August. They hatch in about a fortnight, and the young larvæ feed up slowly to hybernation.

These are only a few "hints" extracted from our work *Practical Hints for the Field Lepidopterist*, and are simply inserted as illustrations of the details to which the attention of the seeker for eggs of lepidoptera must be directed.

## CHAPTER VI.

### BUTTERFLY LARVÆ AND THEIR MOULTINGS.

The newly-hatched larvæ of many families of butterflies are very similar to each other, much more so in many cases than are the newly-hatched and adult larvæ of the same species. The term "embryonic" has been applied to newly-hatched larvæ in their first instar or plumage, *i.e.*, before their first moult, and the term is a happy one, because, structurally, the larva until this moult retains all the characters that the embryonic larva possesses just before it leaves the egg. This stage rarely lasts more than a few days (although *Dryas paphia* and *Argynnis aglaia* are both reputed to have larvæ that leave the eggs in August, and, without feeding, remain in this state till the following March). The marked peculiarity of many newly-hatched lepidopterous larvæ is the similarity in the position and arrangement of certain little chitinous buttons or knobs, each bearing a conspicuous hair or seta; these buttons, with their setæ, are known as the primary tubercles. This similarity the young butterfly larva shares, with scarcely any modification, with the larvæ of most other lepidopterous superfamilies, and, as we know that the embryonic stages often recapitulate the past history of the development of the species, we speak of this general or common form of butterfly larvæ as a generalised type, and consider it as exhibiting, more nearly than the adult larvæ, a primitive or ancestral form of the butterfly caterpillar. With the first (or, at latest, the second) moult a very considerable change takes place, and the larva becomes more specialised.

The larvæ of our butterflies live more or less exposed on their food-plants; their enemies are numerous, and they are sought eagerly by various animals as food. Their colours, hairs, etc., are so modified as to make them difficult of detection on their foodplant in their normal position of rest, or by making them unpalatable if they be detected. Hence the larva of each species is so far modified or specialised in the direction of its colour and markings, or in its armature—spines, hairs,

etc.—or in both, as will best protect it from the enemies which would otherwise prey on it. Similar, therefore, as the newly-hatched larvæ may be, they present, usually, at their first moult, a marked change in their appearance, and this frequently becomes more pronounced at each successive moult until the larva is fullgrown. The difference between the newly-hatched larvæ of the Vanessids, Argynnids, etc., and their adult forms is very great, *e.g.*, compare the newly-hatched and adult larvæ of *Dryas paphia*, *Aglais urticae*, etc. If we study the habits of these larvæ we shall find that these changes culminate in producing just that form which is best protected by the particular environment which surrounds it. The preservation of the more suitable, and the weeding out of the less suitable, individuals by natural causes, is known as "natural selection." Butterfly caterpillars have, therefore, been brought to a high state of fitness to their surroundings by natural selection. Their independent mode of life makes the larval specialisations run in entirely different directions from those which are most effective in the preservation of the pupa, or imago, where the conditions of its environment are so entirely different.

All newly-emerged larvæ, however, do not conform to the generalised type just noted, but hatch from the eggs already in a highly specialised condition, *e.g.*, the larva of *Papilio machaon* is well provided with spinous processes when it leaves the egg, and others have undergone even more development before hatching. We assume that, as these larvæ hatch in a more than usually specialised condition, they go through a generalised stage of development in the egg before reaching this more specialised one in which they hatch, and that these earlier stages have at some distant time taken place outside the egg, and that the necessities of a changed environment have forced these later stages into the egg, so that the larva is more specialised and more able to respond to its present environment when hatching takes place. We have, however, no real evidence that this is the case.

The larva undergoes a certain number of moults or changes of skin before it becomes adult. The period between one moult and another is called a stage or stadium. The appearance of the larva at any particular moult is known as its instar. Thus a larva that moults four times has five stadia, and five different appearances of its plumage or instars corresponding with the stadia. It may be noted that the head, being chitinous, is of fixed size throughout a given stadium, and that this is of great importance in determining the stage in which a larva is, apart from the size of the body. It is also to be noted that, at a larval moult, not only does the larva cast off its old skin, but the linings of the mouth, gullet, and even of the large air-passages are shed as well, and, if the cast-off skin be examined, you may observe the latter as fine thread-like processes curled up, and starting from the spiracles down the sides of the caterpillar's body. Previous to moulting, the larva spins a silken pad on which it rests for two or three days, inserts into this the hooks of its prolegs, and here it remains motionless whilst the new skin is being matured beneath the old one. During this time a surface fluid collects between the two skins, the old skin splits, and the larva in its new skin frees itself from the old one, which remains attached to the pad by means of the proleg hooks, which cling tightly to it.

An excellent account of the exuviation of the larval skin in *Dryas paphia* is given by Buckler, who writes: "I observed the larva in preparation for its last moult, fixed belly upwards to a leaf, on May 20th. It remained quite still until noon of the 25th, when I noticed it moving its anterior legs a little free from the leaf, a circumstance which claimed my whole attention; it was but a slight movement, and was repeated at intervals of about half-an-hour until between 2 and 3 o'clock in the afternoon, when it began to stretch its 1st segments downwards from the leaf, making the forepart of the back concave, and then presently gently reversing the movement. It continued thus at short intervals to increase the stretching curve of the body so much that, by 10 minutes past 3, its hold on the leaf was retained only by the fourth pair of ventral prolegs and the anal pair, when, suddenly, the skin snapped asunder close to the head, with quite a shock to the larva, which instantly returned its ventral prolegs to the leaf, whilst the elastic skin, relieved of the tension, was itself, from the impetus of the rupture, gliding backwards. The anterior legs were held back until divested and then returned forwards to their natural position one after the other, but kept just free from the leaf, each pair being elevated in unison for a moment, and let fall as though to test their complete freedom; otherwise the larva remained passive, the skin only continuing to move backwards, and, whilst passing the ventral prolegs, each foot was lifted up in turn out of it and then replaced on the same spot of the leaf, and, when the old skin had shrivelled up at the end of the body, the larva, with all the ventral prolegs, took two steps forward and drew forth the anal pair free. At the first breaking of the skin the head became exposed, with the old headpiece adhering to the parts around the mouth, but now, at last, the larva gave its head a sudden twist or two, and the old piece fell off. From the rupture of the skin to this final riddance the operation occupied nearly ten minutes; the spines were all uncovered in a remarkably small, wet and flaccid condition, the front pair even smaller than the others, but now this pair began gradually to grow and in fifteen minutes were far longer than ever, and in another half-hour all the other spines had grown considerably both in length and rigidity. After this the larva remained still for 2½ hours longer."

With each moult there is usually some change in the appearance, markings, or structure of the larva. Thus, after the first moult, the larva of *Apatura iris* develops its long horns, the primary tubercles of the Vanessids appear to be replaced by long spines, etc., whilst, on the other hand, in some of the Pierids and Satyrids, they get smaller, and become almost obsolete. Larvæ in which the gradual obsolescence in these tubercles may be well observed are *Euchloë cardamines* and *Pararge megaera*, although almost any members of these families will do. The larva of every species of butterfly will, however, show some modification or other, and all are exceedingly interesting.

# CHAPTER VII.

## EXTERNAL STRUCTURE OF THE BUTTERFLY LARVA.

The butterfly larva is composed of a head, thorax and abdomen. The last two form a cylindrical tube slightly drawn in by a series of constrictions following one after the other, and dividing it into segments, separated by the drawn-in parts or incisions. The head of the larva appears to consist of four segments, in most cases, closely welded together, but in some instances traces of division are here and there noticeable. The newly-hatched larva of *Pararge megaera* also shows a somewhat peculiar development, the last head-segment bearing four typical trapezoidal tubercles, arranged as a trapezoid (as on the body-segments), each carrying the usual hairs. The marks on the other head-segments seem to have the same significance, and it affords strong suggestion that the head-segments were originally ordinary tubercle- and hair-bearing segments like those of the body. It is also interesting to note that the newly-hatched larvæ of *Limenitis sibylla* and *Eugonia polychloros* have fleshy spikes on the head, which are probably of the same origin and significance as the spines of the thoracic and abdominal segments.

The three segments following the head are the thoracic segments, and the ten following these comprise the abdomen. The 1st of the thoracic segments is known as the prothorax, the 2nd as the mesothorax, and the 3rd the metathorax. Of the ten abdominal segments the hindmost is known as the anal segment. There is often considerable difference between the armature or clothing of the thoracic and abdominal segments both as to the structure and arrangement. The prothorax usually differs more from the meso- and metathorax than do these from the abdominal segments; the 8th, 9th and 10th abdominal segments are also generally considerably modified. The number of subsegments, into which the segments are subdivided transversely, ordinarily differs in the thoracic and abdominal segments, the prothorax being usually greatly specialised and differentiated in this as well as in other details. The peculiar structure of the neck-like prothorax of the Urbicolids is very remarkable and exactly opposite to that of the swollen prothorax of the Ruralids or Lycænids, into which the head is freely retractile. There is also a remarkable swollen vesicle, which is placed (usually in a transverse slit) below the 1st thoracic segment, just in advance of the first pair of legs. It is known as the chin-gland. This structure, butterfly larvæ have in common with those of the Notodontides, Noctuides, and a few closely allied superfamilies. Again, the spines or hair-bristles arising from the skin are usually arranged in longitudinal rows, which have a regular position on each abdominal segment; yet, whatever the arrangement on the abdomen, it will usually be found that this either stops altogether, or changes in direction, as soon as the thoracic segments are reached. The thoracic segments bear the true legs, and the meso- and metathorax, under which the structures that will form the future wings begin to develop in the earliest larval life, have no spiracles, although the prothorax carries one on either side. The abdominal segments that are probably

the most modified are the 8th and 10th; in the Satyrids the latter is modified to form a pair of pointed projections extending out behind the larva. The 3rd, 4th, 5th, 6th and 10th abdominal segments each bear a pair of prolegs, the last pair often known as the anal claspers.

The spiracles are tiny holes for the admission of air into the tracheæ or breathing-tubes; they are placed in pairs (one on each side) of the prothorax and the first eight abdominal segments. Each spiracle leads, by means of a little tube, into a larger longitudinal one so that all the tracheæ connected with the spiracles are brought into connection; injury to one spiracle, therefore, throws the work on others and does not kill the larva. It will be observed that the spiracles on the 1st thoracic and 8th abdominal segments are invariably larger than the others, which are usually equal among themselves. The reason for this is obvious, for each has to supply air to a much larger area, the head and thoracic segments being dependent on the prothoracic, and the 8th, 9th and 10th abdominal segments on the 8th abdominal, spiracle. It is to be observed also that these have usually a different position from the others, being generally placed much higher than the other spiracles.

The caterpillar has, as we have noted, three pairs of true legs, one pair situated on each of the thoracic segments. These are usually small, jointed, horny, and provided with terminal hooks, but often so ill-developed as to be comparatively useless for walking purposes. For this purpose, and to support the long cylindrical abdomen, the skin on the underside of the 3rd, 4th, 5th, 6th, and 10th (anal) segments of the abdomen is prolonged downwards to form the prolegs and anal claspers (or false legs), and, to make them more effective for walking purposes, they are composed of joints which are partly retractile one into the other; the end joint of these prolegs is provided with minute hooks, the arrangement of which is most important as giving clues to the line of evolution of the various groups of butterflies. At the same time they enable the larva to cling tenaciously to its foodplant. In the most highly developed butterfly larvæ these hooks exist only along the inner margin of what is now a flange, but what was once a circular pad, and the larvæ of the skippers still have an almost complete circle of hooks on the prolegs, hence the conclusion that the butterflies have been derived from lepidopterous ancestors of a low or generalised type such as the Hepialids, etc., which possess somewhat similar prolegs, and not from the higher or more specialised moths which have the same type as the other butterflies, *i.e.*, excluding the skippers.

We have already referred to the primary tubercles and the hairs carried by them in the newly-hatched larva. It may be well now to note them a little more particularly. The simplest form consists of a little chitinous knob bearing a single hair or seta. Sometimes these are modified so that a slightly raised base bears several hairs, in addition to the primary seta, when we get a tubercular wart; again they may be modified into spines, fascicles of hair, etc. Examination of the dorsum (or back) of a larva will show, at least on the abdominal segments 1-8, two rows of chitinous-based hairs, or spines, running down the length of the body, two on either side of each segment, those in front, rather nearer the middle line of the back than those behind; the front ones are known as tubercles i, or the anterior trapezoidals, the hinder ones

as tubercles ii, or the posterior trapezoidals. Another row is found along the side just above each spiracle, these are known as tubercles iii, or supraspiracular tubercles, another row is placed just behind each spiracle, called tubercles iv, or postspiracular (in many superfamilies of the lepidoptera tubercle iv is subspiracular like v), whilst a row placed directly under the spiracles are called tubercles v, or subspiracular. At the tops of the outside of the prolegs is another series known as tubercles vii, or marginal tubercles, whilst between v and vii is a row of secondary, rather than primary, tubercles, known as tubercles vi. These should be thoroughly worked out by every lepidopterist who wishes to study the structure of butterfly larvæ, and particularly to describe them. We have already stated that the position of those on the thoracic segments is often much modified, and their homologies are not always easily to be determined. The differences in character and position between the corresponding tubercles on the different segments are of the greatest possible importance, particularly is this so in the case of a comparison between the positions of those on the thoracic and abdominal segments.

Besides the hairs or setæ carried by the tubercles, which have fairly fixed positions in all butterfly larvæ, the skin of most butterfly larvæ has, scattered more or less regularly over the body, little elevations, resembling somewhat a fine pile or covering of minute hairs. This pile is a very common feature in butterfly larvæ, is supported by very minute papillæ, and is generally distributed with considerable regularity, usually in a transverse, though sometimes in a longitudinal, direction. It is, however, occasionally scattered irregularly over the body, and when it is arranged transversely, it is usually somewhat closely related to the subsegmental divisions into which the segments are subdivided. It is not at all confined to butterfly larvæ, but is found very generally in those of many other superfamilies. As an illustration of the vagaries connected with its appearance one may note that in the larva of *Aglais urticae* it is strong in the early stages, whilst in that of *Zephyrus quercûs* it is strong when, and not until, the larva is fullfed. Scudder thinks that "the clothing prevents the too rapid evaporation of the heat from the surface of the body, for, although larvæ are cold-blooded animals, they, nevertheless, have an internal heat above that of the surrounding atmosphere, which originates from the activities of the organs and the respiratory functions, and which they would lose more rapidly but for this investing pile."

Many larvæ are provided with what may fairly be termed glandular hairs. They are more especially abundant in young butterfly larvæ and occur in all the larval stages among the Satyrids and Pierids. In the Pierids, they form an open basin, fringed with cilia, supported on an exceedingly slender hollow pedicel. In the basin a drop of transparent fluid may be secreted when the hairs look as if tipped with dew. The purpose of the secretion is possibly protective, as the volume of the fluid is visibly increased when the larvæ are excited. Scudder writes: "They are generally arranged in longitudinal rows, and their use is wholly unknown, but they probably have a protective function, for this fluid is odoriferous, the secretion increasing when the larvæ are disturbed." He describes them as "papilla-mounted bristles, each furnished with a trumpet-mouthed tip," and adds that they "are the ducts leading from glands at their bases, secreting a transparent fluid, which, after secretion, is borne in a

little globule in the mouth of the trumpet, and sometimes kept in its place by a few microscopic bristles which surround its rim."

These glandular setæ are really the hairs of the primary tubercles. Scudder, speaking of the change occurring in butterfly larvæ (*Butts. of New England*, ii., p. 805), at the various skin-moultings, says: The mature Satyrine larvæ have a rough skin the result of a multitude of minute tubercles, each bearing a simple hair scarcely visible to the naked eye; in the young larvæ of the Satyrids, the skin, instead of being supplied with an almost innumerable number of microscopic hairs, is furnished, in some instances, with an exceedingly scanty number of little club-shaped bristles, proportionally many times longer than the hairs of the adult . . . . arranged in definite longitudinal series; in others, with compressed, ribbon-like hairs as long as the body, serrated on one edge and bent in the middle; on the abdominal segments, these hairs point backward, and on the thoracic, forward. In the Nymphalids, the segments of the young larvæ are equal in size, and have regular series of stellate warts; in the mature larva, the body is grotesquely hunched, while the warts have changed to very variable tubercles, etc. In *Anosia archippus* the fullgrown larva is naked, but adorned with a pair of long thread-like fleshy flexible tentacles at either extremity of the body; in the young larva, these tentacles or filaments are absent, but their future position is marked by little conical black points, while the body is covered with minute black bristles, arising from still more minute warts, and arranged six on the back of each segment (? i, ii, iii), and three on either side of the body (? iv, v and vii). In the Vanessids, the larval spines are compound in the adult, and arranged in certain definite rows; in their earliest life, these same larvæ are furnished with long tapering hairs, also arranged in definite series, but not occupying the same positions as the spines of the mature larva. In *Agraulis vanillae* and *Apostrophia charithonia*, two Heliconians, the appearance of the larva after the 1st moult is entirely different from that preceding it. In the 1st stage, the head is unarmed, and the body supports longitudinal rows of very large papillæ, each bearing a long slender naked hair with a delicate ovate apical club. After the 1st moult, the head is armed above with a pair of stout spines nearly as long as itself, bristling with distant thorns; and, in the place of the primary hairs, are long tapering spines as high as the body, with a very slight basal enlargement, and furnished along their whole length with minute papillæ supporting little needles, the position of these spines is quite different from that of the papillæ of the 1st stage, and, as if to mark this more distinctly, there are but three longitudinal series above the prolegs; these differences become intensified in every subsequent ecdysis. The adult Ruralid (Lycænid) larvæ appear to be quite smooth, although covered with microscopic hairs, whilst the newly-hatched larvæ of this group are provided with long spiculate primary hairs that sweep backwards behind their bodies. In the Urbicolids, the primary setæ of the newly-hatched larvæ are always shaped like little clubbed mushrooms. The adult Papilionid larva is always nearly naked; a few scattered hairs may be found with a lens, with a few minute tubercles or smooth and shining lenticles; in some, the front part of the body is swollen, and furnished with striking eye-spots; at birth, however, the body is always cylindrical and supplied with several prominent series of bristle-

bearing tubercles, one tubercle to a segment in each row, and one row often more conspicuous than the others; sometimes the entire body bristles with these appendages.

As has already been noticed, there is, in certain of our British butterfly larvæ—Urbicolid, Pierid, Satyrid, etc.—a tendency to the obsolescence of the primary setæ. In other cases, however, the bases of the tubercles are developed into long fleshy processes, carrying aborted setæ, *e.g.*, in Vanessid, Argynnid, Melitæid larvæ, etc. That these complex processes, often bearing long sharp spines, are modifications of the tubercular structure, and are dermal appendages, appears certain if we examine the newly-cast skin of a Vanessid or Argynnid larva. The structure of the spines of the larva of *Dryas paphia*, the movable prothoracic horns of *Apatura iris*, with moving tubercular bosses, and the anterior flexible filaments constantly in motion backwards and forwards (especially when eating or alarmed), are all important from the point of view of the development of special external structures for protective purposes.

The larvæ of butterflies have then undergone special development along various lines for protective purposes. The resemblance of some, especially grass-feeding larvæ, to their foodplants, makes them readily overlooked; those of the Melitæids closely resemble the long bloom-heads of plantain and allied plants to which some species are attached, whilst those of the Apaturids and others are most difficult to detect owing to their resemblance to the leaves, etc., of their foodplant. Others, again, are protected by the sharp, prickly spines into which the tubercles are modified, *e.g.*, the Vanessids, whilst others again have bright warning colours, or are protected by nutant spines, etc., evaginable osmateria, *e.g.*, the larvæ of the Papilionids. Butterfly larvæ, therefore, show considerable variety in their means of defence and consequent ability to escape their vertebrate enemies. They are, however, subjected to the serious attention of a vast army of smaller foes, especially diptera and hymenoptera, which lay their eggs in them, the caterpillars from these eggs devouring the internal organs of the larvæ, and, after maturing thereon and killing their host, pupating either in the body or directly after leaving it. The destructive powers of some of the smaller species are very great. One minute species lays its eggs in the newly-hatched larvæ of *Melitaea aurinia*, in June, and, according to Wolfe, after the larva stops feeding preparatory to hybernation, the parasite forms its cocoon inside the web spun by the larva, in which to hybernate, and the latter of course dies. The imagines of these ichneumons emerge in spring, sting fresh *M. aurinia* caterpillars, and, so rapidly are their own metamorphoses completed, that even a third brood of the parasites will attack the same batch of larvæ before the latter are full-grown. The destruction caused by such parasites can readily be understood.

Many peculiar structures are to be observed in butterfly larvæ. We have already referred to the chin-glands—eversible bladder-like glands hidden in a slit on the ventral surface of the prothorax, which are everted when the larva is disturbed, but which appear to have no power of emitting any fluid, although it is possible that some scent may render them of service as a means of protection to the larvæ possessing them, and which appear to be general among Nymphalid larvæ. But the most striking of the eversible glands in the butterfly larvæ are the well-known osmateria of the larvæ of Papilionids, Parnassiids and

Thaids, which are placed in a transverse slit on the upper part of the prothorax. When irritated, the larvæ thrust therefrom a large orange-yellow, Y-shaped, fleshy, tubular process (the osmeterium), from which is diffused a very appreciable odour, varying in its nature according to the species, usually more or less objectionable, and, in some cases, exceedingly so; this is frequently accompanied by a drop of fluid which Packard says is acid, and turns litmus paper red. The mechanism has been described and figured by Klemensiewicz. Packard notes that, when at rest or retracted, the osmaterium lies in the upper part of the body in the three thoracic segments, and is crossed obliquely by several muscular bundles attached to the walls of the body, and that by the action of these muscles, the evagination of the osmaterium is strongly promoted. After eversion, the tubes are slowly retracted by two slender muscles inserted at the end of each fork or tube, and arising from the sides of the metathorax, crossing each other in the median line. Secretion takes place in an oval mass of glandular cells at the base of the forks; in the glandular mass is a furrow-like depression about which the secretory cells are grouped. The secretion collects in very fine drops on the side of each furrow opposite the glandular cells. Its particular structure in *Papilio machaon* and the details of secretion and method of movement have already been dealt with (*Nat. Hist. Brit. Lep.*, i., p. 95). We need only add here that the osmateria are probably protruded by the muscular contractions of the walls of the body, forcing the contained fluid into the tube, and thus pressing out the reversed osmaterium.

On the dorsum of the 7th abdominal segment of most (probably all) Ruralid (Lycænid) larvæ is a narrow transverse slit. In this slit, in many species, is a very minute eversible sac, whose function appears to be directly opposite to that of the osmateria already described, for the sac exudes a sweet fluid very attractive to ants, which may be diffused more widely by the delicate spinulose bristles crossing the summit. It is assumed that, in return for a supply of the sweet fluid, the larvæ are protected by the ants from predaceous enemies. Scudder says that all Lycænid larvæ have the slit, though all do not possess the gland; in those that do possess it, it is found to be a vesicle of somewhat tubular shape that can be thrust through the transverse slit, which, when closed, looks exactly like a transverse line running across the dorsum of the segment. The connection between these larvæ and ants has already been noticed (*Nat. Hist. Brit. Lep.*, i., pp. 97-98).

In addition, Edwards states that, in several Lycænid species, there is, besides the gland on the dorsum of the 7th abdominal segment, a pair of minute dorsal evaginable tubercles. The larva of *Pirochala isocrates*, the well-known Pomegranate butterfly, is said by Pargiter to have two white spots near the anal end of the body, in each of which is a small hornlike process, which the larva continually protrudes and retracts. Nicéville gives (*Butterflies of India*, vol. iii) an excellent account of two tubercles with protruding flagella, found one on each side of the 8th abdominal segment of *Curetis thetis*. These are described as two diverging cylindrical rigid pillars, arising from the subdorsal region, and of a pale green colour. When the insect is touched or alarmed, a deep maroon tentacle, as long as the right pillar, bearing on its end long parti-coloured hairs (the basal third black, and the upper two-thirds white), is everted. The maroon tentacle, with its long

hairs spread out like a circular fan or rosette, is whirled round with great rapidity in a plane parallel to its body, its use being, almost certainly, to frighten away its enemies. Similar eversible glands are described by Hagen as occurring in the larvæ of *Plebeius argus* and *Polyommatus corydon*. He writes: "You find on the penultimate segment, outside and behind the stigmata, two large white spots, each of which evaginates a white membranous tube, just like the finger of a glove, the top of which is not entirely drawn out." Exactly what measure of protection is afforded by these flagella is not known, nor the manner in which they afford it. Many authors, *e.g.*, Scudder and Dimmock, incline to the opinion that they are of the nature of osmateria and diffuse odours, but so far the odours do not appear to have been detected. The glands are by no means present in all Lycænid larvæ, closely allied species differing in this respect.

In many lepidopterous larvæ (*Nat. Hist. Brit. Lep.*, i., p. 40) there are present two bristles, each standing out backwards from a papilla, placed directly under the anal flap, sometimes looking as if they projected from the base of the anal prolegs, and used by the larvæ to throw the pellets of frass to some distance from where they are feeding. These are called "paranal forks" or "paranal tubercles." In butterfly larvæ, their place seems to be taken by the "anal comb," which Chapman considers may possibly be homologous with the paranal forks. It is present in Urbicolid larvæ. Scudder also figures the structure in *Colias* (*Eurymus*) *philodice*. It will be dealt with at length in some of our detailed larval descriptions.

One of the most remarkable external features of the Urbicolid larvæ is the development of peculiar glandular structures on the venter of the 7th and 8th abdominal segments in their last instars. We have described them somewhat at length in our descriptions of the Urbicolid larvæ (in the systematic portion of this volume), and there is no need to redescribe them here. They appear, in the case of the Palæarctic species, to be active only in the final larval stage, when the puparium is thickly sprinkled with the asbestos-looking material secreted by these glands, apparently for the purpose of keeping it watertight, but, in some of the exotic Urbicolids, it would appear that the larval shelter itself may be covered with the secretion for the same purpose, *e.g.*, Nicéville notes (*Butterflies of Sumatra*, p. 538) that the larva of *Erinota thrax* is covered with a white waxy powder, and that it lives in a shelter made of a portion of one of the enormous leaves of *Musa*. He adds that the pupa is also covered with the same white powder, which is of the greatest service to the animal, as, in consequence of the heavy showers of rain in the tropics, much water often collects in the rolled-up leaf, and the pupa, if not so protected, would soon be drowned and rot; as it is, the powder keeps the pupa dry until the water has drained away or dried up. The downy larva of the allied *Gangara thyrsis* is similarly covered with a white waxy powder.

Little is known of the remarkable structures, detailed at length in our accounts of the larvæ of the various Urbicolid species, and there called lenticles. Scudder describes them as crateriform chitinous annuli, which are ranged in longitudinal rows along the abdominal (and sometimes the thoracic) segments. They are found only in certain groups, appear to be an universal characteristic of the earliest stage of the Lycænids, having the appearance of spiracles, only they

are usually quite circular, whilst spiracles are ordinarily oval, and they present no opening in the centre, but only a simple pit of more delicate structure than the chitinous annulus itself. They are also found in some Urbicolid larvæ in their first stage and sometimes also throughout life, but for the tenuous structure of the pit in the centre, they would have all the appearance of suppressed spines, and, indeed, the central pit seems sometimes to be wanting, and we have simply a shining lenticle, similar to those which are common in the Papilionids, but whether they should be looked upon as structures on their way to some use, or as effete structures, degenerated spines, so to say, we have no evidence at present to show, and an explanation of their purpose has still to be sought.

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## CHAPTER VIII.

### INTERNAL STRUCTURE OF THE BUTTERFLY LARVA.

The internal anatomy of the butterfly larva is exceedingly complex. The external features of the butterfly larva are comparatively easily described, and the position of the structures located owing to the segmented form of the body, and the fact that special organs and appendages are restricted to certain segments. The dealing with the internal organs and structures, is, however, a much more difficult matter, as most of them are not restricted to certain segments, but run longitudinally through the body, sometimes extending from the thorax, forward into the head, or backward into the abdomen. It is, therefore, necessary to consider each separately, both as regards position and function. The movements of the body are of the first importance, and the larvæ have, in various species, undergone great modifications to enable them to vary their movements according to their needs. Movements are dependent on the muscular system, and the changes that take place in the appearance and configuration of the larva, when movement occurs, are due to the muscles. The nutrition of the various parts is maintained by food, and, to comprehend this, the digestive or alimentary system must be studied. The absorption of the digested food into the blood and its carriage to the different parts of the body, necessitate a circulatory system, whilst the oxygenation of the blood leads up to a consideration of the respiratory system. This latter is so intimately connected with the excretion of waste, that one is forced to consider the excretory system, whilst the organs, by which the whole of these various systems is governed, comprise what is known as the nervous system, and this has to be considered, both in its relation to volition and sensation. These various systems comprise, then, the different organs (and their functions) by means of which the life of an insect is carried on, and their external results, as exemplified by their movements, etc., are the outward signs of their vitality. The reproductive system, which is not, however, matured, nor very largely developed, in the larval stage, must take the highest place in relation to the continued life of the species. Closely related, too, with the digestive, is the cellular system by means of which the caterpillar is able to store up large quantities of surplus material for use in the later stages of its metamorphoses. We

have already dealt with the internal anatomy of a lepidopterous larva at length (*Nat. Hist. Brit. Lep.*, pp. 54 *et seq.*), and, since that of butterflies does not differ, in any of its essential features, from that of other lepidoptera, we shall not do more here than repeat a few of the salient facts, which may be considered under the following heads :—

(1) *The muscular system:* The voluntary muscular system of the larva, is that by means of which it is enabled to move about in order to obtain its food. The muscular fibres are usually arranged as flat ribbons or conical bundles, the latter making up almost the whole structure of the head, and are attached to the headwalls, stretching to the mandibles, labium, labrum, etc. A series of contiguous muscular cords, or bands of longitudinal muscular fibres, run from one end of the body to the other on each side, just under the skin, between the spiracular line and the venter of the body; other longitudinal muscular bands run above the spiracles; a transverse muscular belt encircles the body at the front of each segment, whilst oblique transverse muscular bands run from the front of each segment, and are attached to the medioventral line further back in the segment. Besides these, complicated muscular systems bring about the movements of the legs and prolegs. The involuntary muscular system is principally connected with the digestive and the circulatory organs. The œsophagus is provided with fine longitudinal, and with less well-developed transverse encircling, bands of muscular fibre. The inner coat of the stomach is enclosed in delicate strips of muscular fibre crossing each other diagonally, whilst longitudinal muscles run throughout its length, and the well-developed encircling muscles are similar to those of the œsophagus. The arrangement of the muscular tissue in the intestines, is very similar to that of the rest of the alimentary canal, only the longitudinal bands are often thick and glistening, whilst near where the small intestine joins the stomach, the walls are plentifully supplied with short longitudinal muscles; the diagonal bands and encircling muscles found in the stomach also have their representatives here. The alimentary canal is held in its place by a series of muscular bands attached to the body wall, one set passing round that portion of the intestine where it is connected with the stomach, another set being attached to, and supporting, the posterior end of the small intestine, these muscles stretching horizontally from the middle of one side of the 8th abdominal segment to the opposite side.

(2) *The alimentary system:* The mouth opens into a short gullet, and this in turn expands into a crop and gizzard, before it extends into a somewhat wider sac or stomach, which in its turn narrows into the intestine and ends at the anus. The nutritious parts of the food when dissolved are absorbed almost directly into the blood. A number of long tubules pass into the œsophagus and appear to represent the salivary glands of the higher animals, a fluid being discharged which is swallowed with the food; the fluid dissolves certain parts of the food, fitting it to soak through the walls of the alimentary canal so that it can enter into the system. The crop is a sort of food-receptacle, from which the food is passed on to the gizzard, provided with somewhat hard plates for the grinding up of the food, the latter being then passed into the stomach, the walls of which secrete another fluid that renders still more of the food soluble, this part being then readily absorbed by the walls of the stomach and

intestine. Near the union of the stomach and the small intestine a number of tubular glands, supposed to represent the liver of the higher animals, open. The intestine ends in a chamber called the cloaca, in which the indigestible and waste portions of the food are collected before being expelled from the body as fæces.

(3) *The circulatory system:* The blood circulates, not through actual blood-vessels but, through lacunæ or hollow channels in the tissues. The blood is collected into a longitudinal membranous sac which is placed just beneath the skin, in the middle of the dorsum or back, and is known as the "dorsal vessel," and its rythmic contraction, when it drives the blood into the tissues, can be detected in some of the more thin-skinned lepidopterous larvæ. In a larva of *Brotolomia meticulosa* it was observed to beat 44 times in a minute. The functions of the dorsal vessel are analogous with those of the heart in the higher animals, but it consists of only one chamber, although the latter is divided into a number of sacs. The muscular tissue of which it is formed contracts from its hinder part forwards, *i.e.*, towards the head, and, by its contraction, forces the fluid in it out in front into a number of little vessels which soon come to an end in the little hollow passages or lacunæ in the tissues. These lacunæ are very abundant around the tiny air-tubes which branch off from the tracheæ, and it is here, after the blood has been over the system, that it is aërated. From here it is carried to the dorsal vessel again to be once more distributed over the system to be again aërated and to be returned again to the dorsal vessel or heart. In vertebrates, the nervous system is placed dorsally, and the circulatory and respiratory systems ventrally, in relation to the alimentary canal. These positions are exactly reversed in insects, the nervous system being placed ventrally, the circulatory and respiratory systems dorsally, the alimentary canal being placed between them. It has, however, been shown that this difference is more apparent than real, the dorsum of the insect being really analogous with the venter of the vertebrate, but with the position of the limbs reversed. The dorsal vessel, although consisting of only one chamber, is divided into 8 or 9 sacs, the latter with openings along the sides called ostia. It is composed chiefly of muscular tissue, and is connected with the roof of the body by short stout muscles, which keep it in position. In its passage through the tissues, the nutritious parts of the food, which soak through the walls of the stomach and intestine, enter the blood in the lacunæ found near these organs. The blood of insects is so different from that of vertebrates, that one feels that it is a great mistake to call them by the same name. Its function is to carry the nutritious matters to the tissues, and to feed, as it were, the tissues it bathes. It is frequently filled with somewhat crude fatty matters, and Gräber calls it a refined or distilled chyle. Beneath the dorsal vessel, a fine membrane is stretched in such a manner as to separate the dorsal vessel from the surrounding organs and, at the same time, leave a cavity around the dorsal vessel itself. This cavity is called the pericardial cavity or sinus. The membrane itself is incomplete, and, when certain muscles contract so as to pull it down tightly upon the tissues below, the movement at once increases the size of the sinus. The tissues thus pressed upon are full of chyle and blood, and the fluid is squeezed from these structures through the incomplete membrane,

into the pericardial cavity, and from thence re-enters the dorsal vessel again.

(4) *The respiratory system:* The air is conveyed into all parts of the body by means of the tracheæ, elastic tubes, held open by an inner chitinous layer, which are all intimately connected. Large tubes connect the spiracles longitudinally, others pass from one side of the body to the other, whilst a set of tracheæ in the lower part of the body, is connected with another set in the upper part by ascending tubes. These main branches give out small branches, which fork in all directions, and by them the body is supplied plentifully with air. The tubes have a white glistening appearance, and hence can be readily detected in a freshly killed insect without difficulty. The finest tracheal tubes are supposed to penetrate cells, but it is not known whether they terminate with open or closed extremities.

(5) *The fat-body:* The fat-body is a very prominent part of the structure of lepidopterous larvæ. It consists of fat masses of various sizes and colours, loosely connected together, and enveloping most of the organs. It varies in colour and appearance in almost every species, and appears to consist essentially of a reservoir, as it were, of reserve material, which increases in the larval stage, when feeding is going on rapidly, and upon which the insect can draw in the future, when it is unable for a long period to take food, *e.g.*, at the exuviation of each larval skin, and the more exhausting periods of metamorphosis. It must also be looked upon as material which the insect can utilise, during the period of histogenesis in the pupal stage, in the formation of the imaginal structures. Bessels notes that in *Pieris brassicae*, the fat-body is white. Jackson, however, observes that, in *P. brassicae*, the fresh fat-body posteriorly to the 6th segment is greenish or olive-yellow, anteriorly to it, opaque yellow or green on the dorsal aspect, but on the ventral aspect, white. He also says that the fat-body of the larva of *Vanessa io* is yellow, and that it becomes orange in the pupa.

(6) *The nervous system:* The nervous system of the caterpillar is, in its broad outline, not very dissimilar from that of the butterfly and is very interesting, and its structure helps to explain why it is that, when the thorax of the butterfly is crushed and the insect is, to all appearances, dead, the abdomen, head and antennæ continue to twitch and move, and give to the kindhearted, but ignorant, observer, the notion that one's cruelty is unbounded in pinning an insect alive to suffer tortures through being spit on a pin when in a moribund condition. The fact is, the central nervous system of an insect is apparently very different from that of vertebrate animals, and is situated in the ventral or belly part of the body, not, as in the latter, in the dorsal. In each of the abdominal and thoracic segments there are two ganglia (little masses of nervous tissue) placed one on either side of the central line. In the head, which appears to be composed of four segments, the eight ganglia are massed together around the œsophagus. Each ganglion is united to its fellow in the same segment by minute transverse nerve fibres, whilst other fibres pass from it in a longitudinal direction to the ganglia of the same side, next in front of and behind it. In addition, the ganglia of the thorax and abdomen give origin to numerous nerves which are distributed to the organs of alimentation and circulation, and to the muscles, those from the thoracic ganglia being chiefly distributed to the muscles that move the wings (when these organs are present).

From the ganglionic mass in the head arise the nerves which supply the eyes and antennæ, so that this is evidently the nerve-centre for such special senses as insects may possess. If now we turn to the vertebrates, we shall find that their central nervous system consists of two distinct parts: (1) The brain and spinal cord, placed in the skull and vertebral column. (2) The sympathetic nerve system, which is composed of a double chain of ganglia running through the neck thorax and abdomen in front of the spine. The nerves which arise from this double chain of ganglia supply chiefly the digestive canal and the walls of the blood-vessels, but some of them join the nerves which spring from the brain and spinal cord, and thus connect the two systems together. The nerves from the brain and spinal cord are principally distributed to the skin and muscles of the body and convey impressions from them to the centre, giving rise to sensation, and from the centre to the muscles, giving rise to movement; those from the spinal cord are provided near their origin with independent ganglia by means of which certain automatic movements, and others called "reflex," can be carried on without the intervention of the brain. The ganglia and the nerves in the thorax and abdomen of an insect are similarly automatic in their action. When the thorax is pinched the nervous tissue in it is crushed and its functions abolished, so that no pain is felt when a pin is thrust through it. The insect, however, still moves the abdominal segments and the antennæ, because the muscles, which effect this movement, derive their supply of nervous force from the ganglia situated respectively in those parts which have not been included in the pinch, and which act independently of each other. It must not be supposed that the ganglia in the head are, to any considerable extent, comparable with the brain of the higher animals; there is no evidence that they are in any special degree the centres for sensation, other than sight or smell, and it is highly improbable that insects feel pain even in the slightest degree. This hurried sketch of the nervous system of insects will help us to understand why a wasp, whose abdomen has been severed from its thorax, will go on sucking up juices, even those exuding from its wounded body, for a long time after the mutilation has occurred. Although, as noted above, apparently so different, the development of the nervous system in the embryo is analogous with that of vertebrates, and, although the nervous system of insects is apparently ventral, whilst that of vertebrates is dorsal, the ventral part of an insect corresponds with the dorsal part of a vertebrate, *i.e.*, in reality, opposite parts of the body are placed ventrally in insects and vertebrates respectively, owing to the limbs being turned in opposite directions in the two cases.

(7) *The reproductive system:* Herold, as long ago as 1815, figured the changes that he observed the essential reproductive glands to undergo in the larva and succeeding stages of *Pieris brassicae*, but, up to the present time, there appear to have been no external openings, in connection with the sexual organs, discovered in any lepidopterous larva. The internal glands, however, are not difficult to observe in some larvæ, and can usually be obtained by a little careful dissection. The testes and ovaries are placed just beneath the skin of the 5th abdominal segment. They exist in pairs, one on either side of the dorsal vessel, just above the position of the alimentary canal. The

testes form two lobes of a not very distinctly reniform shape, whilst the ovaries, which are only to be seen with a lens, and then in comparatively few species, are much smaller and consist of tubes. The testes are generally much more readily observed than the ovaries, being usually yellow or brown, and may be seen distinctly in the larvæ of those species of lepidoptera that feed internally, or that have fairly transparent skins. Jackson says that the larval ovaries are situated in the 5th abdominal segment and close to the dorsal middle line. Their proximal or attached extremities are approximated, and they diverge from one another posteriorly. The colour gets deeper during the quiescent period preceding pupation. Four opaque white lines, the future ovarioles, traverse the larval ovaries lengthwise, and converge towards their hinder extremities, from which the larval oviducts spring. The latter are very delicate filaments, and difficult to make out. Bessels notes of *Pieris brassicae* that the ovary is yellow, the testes violet, the fat-body white.

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## CHAPTER IX.

### THE ASSOCIATION OF ANTS WITH BUTTERFLY LARVÆ.

A matter, of which little is known, has here to be considered, *viz.*, the character of the association of ants and certain Ruralid larvæ. On the middle of the dorsum of the 7th abdominal segment in these larvæ is an evaginable gland, which, in some species, secretes tiny drops of sweet fluid, greedily lapped up by ants, that stroke the larvæ with their antennæ until the desired liquid is obtained. Other allied larvæ are said to possess the gland. without, however, its having any secretive powers, and it is recorded that these larvæ are not accompanied by ants. Until, however, many more observations have been made, this latter conclusion must be accepted with great caution. It is assumed that, whilst the ants benefit by obtaining the saccharine fluid desired, their presence tends to warn off ichneumons and other enemies that prey on the larvæ. Scudder observes that "it is a curious thing that, among the *Lycaenidi*, the glands are found in some species, whilst not in others closely allied; their presence in many members of the other two tribes of *Lycaenidae*, together with the impossibility of their independent origin in different genera, render it probable that these glands first arose as long ago as before the differentiation of the three Lycænid tribes; the brotherhood of the ants and caterpillars may, therefore, be of great antiquity." Scudder says that Esper was the first to notice the relation of the larva and the attendant ants, and that Guenée observed the gland in the larva of *Lampides boeticus*, describing and figuring it, whilst Freyer figures the gland as two white dots in the larva of *Plebeius argus*, but does not describe it. Scudder observes that the gland is present in the larvæ of many hair-streaks, and in that of *Thestor ballus*, although the association of ants with these larvæ has escaped notice.

Edwards gives (*Can. Ent.*, x., pp. 131-136) a detailed account of the connection between the larvæ of *Cyaniris pseudargiolus* and their attendant ants. He noted that ants frequented the same

flower-spikes as the larvæ, and thought they were attracted by the nectaries of the flowers, until he observed an ant running up and down the back of one of the larvæ, drumming and gesticulating with its antennæ, the feeding larva not at all disturbed by the treatment. Three kinds of ants were observed, and, on one occasion, six examples of a small ant were seen to be busy with one larva at the same time, but the movements of all the species were similar. They run over the body, caressing the larva incessantly with the antennæ, and undoubtedly with the object of persuading it to emit the fluid. Much of the caressing is done about the anterior segments, and, while the ants are absent from the posterior segments, the tubes (on the 8th abdominal) are almost constantly exposed to their full extent, and so remain, without contracting, until the ants come tumbling along in great excitement, and put either foot or antenna directly upon, or close by, the tubes, when these are instantly withdrawn. The ants pay no heed to these tubes, so far as touching them with intention, but at once turn to the median gland, caress the back of the 7th abdominal segment, put their mouths to the orifice, and show every sign of eager expectancy. With a lens, a movement will speedily be apparent, a dark green mammilloid membrane will protrude, from the top of which exudes a tiny drop of clear green fluid. This the ants drink greedily, two or three of them perhaps standing guard over it. The demonstrations of the ants are of the most gentle nature, caressing, entreating; and, as the little creatures drink the fluid, they lift their heads as if to prolong the swallowing. There is a manifest satisfaction and delectation that is amusing to see; they lick away the last trace and stroke the back of the segment, and wait to see if their coaxing avails anything; if not, they run about, but presently all return and the caressings go on as before. The intervals between the appearance of the globule vary with the conditions of the larva; if exhausted, by yielding to the frequent solicitations, some minutes may elapse, and the tubes, meanwhile, will remain concealed; but a fresh larva requires little urging, and the mere intimation of the presence of an ant in the vicinity is enough to cause the tubes to play rapidly, and one globule to follow another, sometimes without a retracting of the membrane and before the near approach of the ants; six emissions were once counted in 75 seconds. The tubes are usually expanded when the ants are away from the posterior segments, and are retracted when they come near; counting the length of these periods of complete and quiet expansion, they were found to be 10, 20, 50, up to 80, seconds, the period always ending with the approach of the ants. Experiment, by placing larvæ upon stems of the growing plants where the ants had access to them, showed that, as soon as the ants discovered one of them, there was an immense excitement and a rush for the hinder larval segments; the larva forthwith relieved itself by the excretion of the fluid, and the tubes stood out with tops expanded between the periods. A larva, placed on a stem on which there were no ants, showed no excitement, no appearance of the tubes, and no movement of the median glands; if ants were transferred to the stem, the larva at once changed its behaviour. Scudder adds that, it is only in the later stages that the ants attend the caterpillars, or any fluid is excreted from the median gland, though the organs are certainly present at an earlier stage. Edwards further finds the attendance of the

ants to be confined to the summer broods of caterpillars of *Cyaniris pseudargiolus*, and, even then, to those on *Cimicifuga*, and suspects that the larvæ feeding on *Cornus* or *Actinomeris* cannot exude so sweet a fluid, the flower of *Cimicifuga* being of exceeding sweetness, whilst that of *Actinomeris* is bitter to the taste.

Saunders notes (*Can. Ent.*, x., p. 14) that the larvæ of *Rusticus scudderii* (closely allied to the European *Plebeius argus*) are accompanied by ants, and that the discovery of the larvæ was made comparatively easy from the invariable presence of these active attendants. The ants were observed actively running about the leaves on which these caterpillars were found, and repeatedly over the caterpillars themselves, which did not seem in the least disturbed by them.

Edwards also gives a most interesting account of the connection between ants and the larva of another Lycænid, *Rusticus melissa* (*Papilio*, iv., pp. 92-3). He notes that, on June 9th, he introduced a small ant to a larva of this species, which was confined in a glass tube. The ant soon discovered the larva and ran about it in great excitement, caressing it with its antennæ. Immediately the tubes, not hitherto seen, began to play, and one or the other, or both together, were exposed for some minutes, and, indeed, so long as the ant was near. Sometimes the tubes were fully protruded, with the tentacles expanded, at other times they were partially withdrawn, in that case coming together in a pencil just as has been observed in *C. pseudargiolus*. The ant always ended its caresses by putting its mouth to the orifice of the gland on the 7th abdominal segment; and, by its motions, evidently found the fluid it sought. Next day, two ants of a larger species were turned in at the same time; they ran about the glass, alarmed at finding themselves in confinement, and accidentally one soon touched the larva; at once a drop of green fluid bubbled out of the orifice before the tubes made any movement. The ant saw it, rushed at it, and then the tubes began to play although they had been quiet for fully five minutes before; they now played intermittently for two or three minutes, the tentacles fully expanding and then partly retracting. The ants drank of the drops four times and then desisted, running about the glass again; then they were liberated, and a small ant of the species experimented with the preceding day, was introduced; almost at once it found the larva, caressed it gently, and was favoured with the coveted nectar, the tubes being all the time in motion. On June 12th, the larva now being mature, another ant was introduced; as usual, as soon as the manipulations began, the tubes commenced to play, and, presently, a large drop issued; in ten seconds another followed, but for some time after there was no more, though the ant begged urgently for it. The ant left the orifice, ran up and down the body of the larva, caressing the anterior segments, and then returned to the orifice and begged again; this was repeated several times, but the larva was obdurate, probably it was exhausted, being near pupation. The solicitations are made by the antennæ alone, which fly about drumming here there and everywhere, the ant manifesting great excitement. Edwards notes that he was observing larvæ of *Cyaniris pseudargiolus* at the same time, and the behaviour of the two species was identical.

Nicéville observes that many Lycænid larvæ in India are provided with an oval opening on the dorsal line of the 7th abdominal

segment, with lips like a mouth. These lips can, at the will of the larvæ, be somewhat protruded, and a drop of sweet liquid exuded. The larvæ possessing this gland are greatly affected by ants of different species, which, in return for the food they obtain from the larvæ, act as their most efficient guardians. He says that he has found as many as four species of ants attending one species of larva. Ant-tended larvæ are most easily found by looking for the ants. The larvæ are usually coloured like the leaves, buds, flowers and seedpods on which they feed, and, for other reasons, are not easily seen; but the restless red or black ants are very conspicuous. *Curetis* larvæ, which are not attended by ants, have a highly-developed eversible organ on either side of the 8th abdominal segment, apparently for protective purposes; in other larvæ, attended by ants, the organs on the 8th abdominal segment are smaller than in *Curetis*, and are, one supposes, gradually becoming aborted, probably because, the ants having constituted themselves their defenders, there is no further use for them for defence, but Edwards possibly correctly surmises that in their aborted condition they serve as signals to the ants to examine the 7th abdominal segment for the sweet fluid emitted by the larvæ. Doherty has recorded (*Journal As. Soc. Beng.*, lv., pt. 2, p. 122) some interesting observations on the same subject; so also has Mrs. Wylly (*Journ. Bomb. Nat. Hist. Soc.*, iii., p. 164). Not only do the ants attend the larvæ from their very first and smallest stages (some ants were found attending larvæ of *Rapala schistacea* only $\frac{1}{8}$ in. long), until they are fullgrown, but they often cause the larvæ to change to pupæ within their nests, in this manner protecting them from harm from the time they emerge as minute caterpillars from the egg, until they assume the pupal stage. Nicéville also mentions that *Aphnaeus vulcanus* is attended by the black ants, *Pheidole quadrispinosa* and *P. cremastogaster*, and that *Gerydus symethus* and *Tarucus theophrastus* are also attended by ants. Green says, "The larvæ of a Cingalese Lycænid, *Aphnaeus lohita*, Horsf. (=*lazularia*, Moore), frequent the nests of *Cremastogaster*, on *Acacia* and *Grevillea* trees, upon the foliage of which they feed. These larvæ carry a dorsal honey-gland near the posterior extremity of the body (7th abdominal segment), and are cultivated by the ants on this account. They are herded in special shelters built by the ants, are driven out at night to feed, and brought back to their shelters each morning" (*Ent.*, xxxv., p. 202).

On this subject, Doherty writes (*Journ. As. Soc. Beng.*, lv., pp. 122-173): "Dr. Thwaites (in Moore's *Lepidoptera of Ceylon*) says, 'Nature, however, finds a protection for these helpless Lycænid larvæ, in the instincts of an ant, *Formica smaragdina*, Fab., which, finding a substance most palatable to it, secreted naturally from a glandular defined spot upon the body of the larvæ, takes possession of them as cows, surrounding each separate one, and the leaf on which it feeds, protecting them jealously and attacking most fiercely any living thing intruding upon them.' Besides a remark of Herrich-Schäffer's, quoted in Distant's *Rhopalocera malayana*, that *Gerydus symethus* inhabits ants' nests, I have met with no other mention of this singular habit. I have, however, myself observed it in quite a number of Indian *Lycaenidae*, belonging to several distinct groups, and feeding on the leaves of various trees and herbs. The larvæ in question, are all very helpless and inactive grubs, slug-like in shape, tapering at both ends,

pubescent-green or brown, with a very small pretractile head. On each side of the 8th abdominal segment above, there is a short protuberance, from which can, in most cases, *e.g.*, *Tarucus theophrastus*, be extended a brush of hairs, and apparently absent in *Azanus ubaldus*. This is, I have no doubt, a scent-gland, and may be intended to attract the notice of the purblind ants. On the dorsal line of the preceding segment, there is another short tubercle exuding a viscid juice. It exists in all the *Lycaenidae* known to me, whether they are maintained by ants or not, and from it issues a gummy thread, by the aid of which, I believe, the caterpillars sometimes swing themselves from branch to branch, or attach themselves to leaves. But, though in all probability acquired for such purposes, it is peculiarly attractive to ants, which, at all hours, surround the caterpillar, and, by stroking and tickling it with their antennæ, induce it to yield up this sweet (?) liquid. I have not yet found any caterpillar in the possession of web-making or arboreal ants, such as *Formica smaragdina*, and no restraint, such as Dr. Thwaites mentions, was placed upon any larva observed by me; but the ants would always remain near the caterpillar, and would always fly fiercely to the rescue if anything molested it. When it had attained its full-growth, the ants, forming a circle round it, would forcibly drive it down to their nest at the foot of the tree. This sight is rather an amusing one, the caterpillar often showing the greatest reluctance to leave its pasture ground, and manifesting strong doubts as to the intentions of its escort. I was struck with the forbearance and patience of the ants which carefully abstained from any violent use of their formidable jaws, though the journey was sometimes prolonged to six or seven hours. Having arrived at the foot of the tree, the ants deposited the caterpillar in an open space just within the mouth of the nest, whereupon the latter would attach itself to the bark, and there commence its transformations. I have counted as many as thirteen chrysalids of *Azanus ubaldus* so attached, in one nest, at the foot of a kind of bàbul tree, *Acacia leucoplaea*. The instinct which induces the ants to preserve these caterpillars in their nests, thus sacrificing a large present supply of food to the possibility of a future supply of the sweet juice they are so fond of, strikes me as one of the most remarkable things in nature."

Nicéville gives (*Journ. Bomb. Nat. Hist. Soc.*, iii., pp. 164-168) further details on this subject, observing that, in Calcutta, he has found the larvæ of over a dozen *Lycaenidae* affected by ants. The most important part of the paper, however, consists of a series of observations on *Tarucus theophrastus*, Fab., by Mrs. Wylly, who writes: "The larvæ of *Tarucus theophrastus* are cultivated and protected by the large, common, black ants of Indian gardens and houses. The caterpillar, which varies in colour from light pure green to a dark reddish tint, is about ·75 in. in length, louse-like in shape, and slow in movement, feeding on *Zisyphus jujuba*, with an edible astringent yellowish fruit. On the dorsum of the 7th abdominal segment is a small slit from which the larvæ exude a small drop of a juice of some sort, eagerly sought by the ants, and which they can generally procure by stroking the larvæ gently with their antennæ. The ants set up what appears to be merely a temporary nest at the foot of the tree the better to carry on their operations. Just before the rains set in, about the middle of June, great activity among the

inhabitants of a *Zisyphus* tree may be observed. The ants are busy all day long running along the branches and leaves in search of the larvæ, and when they meet one fullgrown and ready to pupate, they drive the caterpillar down the stem of the tree towards their nest. As a rule, the larvæ are docile and easily led, and, having got him into his proper place he undergoes transformation into a pupa. If one gently scrapes away the loose earth piled up at the base of the tree, one will see some hundreds of larvæ and pupæ in all stages of development arranged in a broad even band all round the trunk and lightly covered with earth. The ants object to their being uncovered, and will immediately set to work to recover them, and, if one persists, they will remove all the chrysalids and bury them lower down. . . . . A larva of a species of *Catopsilia* (one of the *Pierinae*) given to the ants as an experiment, was immediately set upon and torn to pieces in a second by the ants. A larva of *T. theophrastus*, taken from a tree, was introduced into the pathway of another company of the same species of ants, which lived on our verandah, but kept no "farm." It was odd to see the ants come tumbling over headlong to fight the intruder, and the sudden way they cooled down on investigation of the foe. None attemped to harm him, and he was politely escorted across their boundary, the ants running alongside, and feeling him all over with their antennæ. This must have been instinct as they could have had no former knowledge of him as a "milk-giver." The ants distinguish between dead and living pupæ, the dead chrysalids being carefully removed and thrown away outside."

Distant mentions that the larvæ of the genus *Amblypodia* are attended by *Formica smaragdina*, Fab. Bethune-Baker says that the larvæ of almost all the species of the Australian genus *Ogyris* are probably attended by ants, some apparently by different species in different neighbourhoods, whilst Dodd records that *O. zosine* is attended by two species of *Camponotus*, and also by a small black ant (*Trans. Ent. Soc. Lond.*, 1905, pp. 269-270). Of *O. zosine*, Bethune-Baker writes (*op. cit.*, p. 279) that the larvæ feed on *Loranthus linophyllus* and *L. celastroides*, and hide in the cracks of the bark of the host tree . . . . coming out at dusk and feeding at night, at which time the ants associated with them are likewise said to be on the move. The species that Dodd has found them with most commonly is *Æcophylla virescens*, but several other species also associate with them. They evidently protect the larvæ, and have been observed to milk them; in one instance, an ant was observed to approach a larva and wave its antennæ over its terminal segments, and then to lightly touch it with its foreleg, when a small globule of liquid was emitted from a small, retractible, nipple-like organ on the dorsum, which was at once sucked up by the ant. Lyell and Fricot (*Vic. Nat.*, xxi., pp. 166-167) have confirmed these observations, and state that, in order to test the action of the attendant ants, one or two larvæ were placed a couple of feet or so away from a tree; they were, however, soon discovered, and dragged carefully back to the tree by the ants, at a pace much more rapid than their own rate; pupæ were likewise carried back to the tree. It is recorded also that "ants are always found with the larvæ of *O. abrota*. Anderson further observes (*Victorian Butterflies*, pp. 101-102) that the larvæ of the genus *Ogyris* are greatly attractive to ants, which tend them with great care, never leaving them. Raynor notices (*in*

*litt.*) that, at Paramatta, N.S.W., from 1877-1880, he frequently found the larvæ of *Ialmenus ictinus*, a Theclid superficially resembling our *Zephyrus quercûs*, feeding on *Acacia decurrens:* at first, he obtained them by beating, but afterwards by searching, when he was greatly surprised to find numbers of ants running excitedly backwards and forwards over the larvæ. He says that it seems to him most interesting that the power of exuding an attractive secretion should extend to the far-off region of Australia. Anderson says (*Vict. Butts.*, pp. 98-99) that the ants affiliated to the larvæ of *I. ictinus* are particularly large and fierce. He also observes that the larvæ of the allied *I. evagoras* are gregarious, and invariably attended by ants.

The connection of at least one British species, *Lycaena arion*, with ants, has been observed and commented on. Frohawk noticed that the butterflies of this species showed a preference for laying their eggs upon thyme plants growing on the nests of *Formica flava*, and suspected some connection between the ants and larvæ. He placed a living larva of *L. arion*, that had passed its 3rd moult, into a box with four examples of *F. flava*. They immediately ran to it, and, waving their antennæ over and upon it, apparently smelt and licked it, and seemed particularly attracted to the hinder part of the back, about the 10th segment, *i.e.*, the 7th abdominal segment. First one and then another of the ants would run over the larva, and then stop to lick that part of its back. He then noticed a tiny bead of moisture appear, and one of the ants touched it with its mouth, which instantly caused the bead to disappear. Examination of the larva and ants under the microscope showed a small elongated transverse gland on the dorsum of the 10th segment. Examination of another larva in the same stage showed the gland which kept throbbing while the larva was feeding. The ants were placed close to the larva, and they soon ran over it. Directly a foot touched the gland, or a place very near it, it immediately throbbed more violently and swelled up, and then ejected a globule of clear white liquid, which was immediately licked up by an ant. In a few seconds a foot again touched the gland, and another bead of liquid oozed out, which was at once again licked up by an ant. An interesting fact is, that the larva unheeded the ants running over and around it while it kept feeding, but the gland is apparently exceedingly sensitive to the touch of an ant's foot, and, although Frohawk several times touched the glands of several larvæ with the point of a very fine sable-hair brush, they would at once wince and contract, but on no account could the exudation of the liquid be induced, yet directly an ant's foot, or the claws of the foot, touched it, a bead would appear, and at once be imbibed by the ants. Although the larva was kept in a box with numerous ants, both workers and winged females, together with their pupæ, the ants one and all acted precisely similarly; not one attempted to bite the larva, but, as soon as they touched it, they slowly closed the jaws and waved their antennæ over and upon it. The gland is of peculiar construction, being formed of flexible tissue, and surrounded by numerous glassy-white pyriform processes varying in size; some are extremely minute, those bordering the edges of the gland are furnished with excessively small white bristles, each process bearing four or five; these are in the form of a fan with diverging points, and all are directed towards the central aperture, the whole forming a fringe surrounding the gland, and are obviously for the purpose of holding

the bead of liquid in place, and probably also serve as a protection to this apparently sensitive organ. The larvæ appear to be perfectly at home with the ants, neither molesting the other (*Entom.*, xxxvi., pp. 58-60).

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## CHAPTER X.

### CARNIVOROUS HABITS OF BUTTERFLY LARVÆ.

The fact that, under certain conditions, in confinement, lepidopterous larvæ will live on others of their own or different species, is well known, and the habit of the larva of *Thecla w-album* to leave its food and feast on the newly-formed pupæ of its own species, has frequently been observed and recorded. That certain butterfly larvæ should, however, have a permanent carnivorous diet, is sufficiently unusual for us to devote a short space to the details of one or two of these cases.

The best known of these species is *Feniseca tarquinius*, an American insect which Scudder makes a Chrysophanid, and which is undoubtedly a Lycænid *in sens. lat.* The larva of this butterfly is purely carnivorous. The eggs are laid in the midst of a group of aphides, or near thereto, and, for protection, are coated during deposition with a thin coagulated albuminous deposit, which, on hardening, covers them like a thin but irregular veil, the egg-stage lasting only three or four days. The larva appears to live entirely on plant-lice, particularly affecting the species *Schizoneura tessellata* (on alder), *Pemphigus fraxinifolii* (on ash), *P. imbricator* (on beech), all of which produce much flocculent and saccharine matter; it has also been fed on aphides from willow and plum, in confinement. The young larva eats a hole through the summit of the egg, and pushes its way under the larger aphides, and forthwith begins to spin for itself a loose web, not close enough to conceal it from view were the aphides away, but sufficient to keep the aphides from walking over the body, and to protect it when a moult is approaching, and the skin sensitive. The web seems to be just about the length of the larval hairs from the body. The aphides may be seen running over it, and often get their legs fast in the meshes, and are apt to be devoured as a consequence; the larvæ appear to pass both the first and second moults beneath this web, but, after this, seek fresh supplies of food, devouring the aphides from the underside, their backs covered with wool from their victims (*Butts. New Engl.*, ii., pp. 1022 *et seq*). The most remarkable fact, however, connected with this larva, is that the ants, which nurse other Lycænid larvæ, are its sworn enemies, for, by feeding on the aphides that the ants keep, they destroy the source of supply of the ants' sweet food (secreted by the aphides), and are furiously attacked and killed by the latter; it appears only to be in their later stages, when feeding largely exposed, that the ants are able to successfully deal with them.

Kershaw gives details (*Trans. Ent. Soc. Lond.*, 1905, pp. 1-4) of the connection between the Chinese *Gerydus chinensis* and aphides, chiefly those frequenting various species of bamboo, the eggs being laid among a crowd of aphides, and often hidden under a mass of them. They hatch in about four days, the larva at

first being cylindrical, and later slug-shaped, the head retractile. The larvæ feed on the aphides, pressing them against the plant with head and forelegs, sometimes holding them in the forelegs quite away from the plants; a few bites dispose of an aphis, and the larva then licks and cleans its legs, just as a mantis does; some aphides must have a better flavour than others, as the larvæ pick and choose, moving their heads up and down over the backs of the insects, evidently smelling them; as a rule, the creatures seem to make little attempt to escape till they are actually bitten, when struggling is useless. When not engaged in feeding, the larvæ rest among the aphides, or crawl about between, or over, them, and the aphides do likewise, the larvæ sometimes covered with them. The larvæ have been observed to feed only on two kinds of aphides, one slate-coloured with white efflorescence, the other greenish, with four dark green patches, some of them being fringed with white, probably moulted skin. The larval state lasts about fifteen days, and it was reckoned on the average, from first to last, that a larva ate some twenty aphides per day, but it would require many larvæ to make much impression on the crowds of aphides one sees, for often a yard of bamboo stem, two or three inches in diameter, is absolutely covered with these insects. One of the features of this larva is the calm way it moves about among the aphides and selects its prey, and the indifference with which the latter apparently accepts its fate. Although Kershaw notes that the aphides are overrun by a host of ants of the two species, *Polyrrhachis dives* and *Dolichoderus bituberculatus*, he notes no signs of enmity between the ants and larvæ, possibly because of the abundance of the aphides.

Holland records (*Can. Ent.*, xix., pp. 61-62) the receipt of a large ♀ of *Liphyra brassolis*, captured in Penang, upon which was, at the time of capture, a quantity of fluff-like mildew, particularly thick on the abdomen and underside of the wings. This fluff was proved to be the mealy covering of certain "shield lice," a few specimens of a large species of which were in the same consignment. Holland at once concluded that—(1) The captor had caught the specimen of *Liphyra* near a colony of scale insects, which were so large as to attract attention, and lead him to put a few into papers. (2) This ♀ was engaged in oviposition just before she was captured, and that (3) the mealy-white deposit described as "fluff," and which was compared with mould or mildew, was nothing less than the fragments of the white covering of the scale-insects over and among which the butterfly had been flying whilst engaged in the act of laying her eggs. Dodd observes (*Ent.*, xxxv., pp. 153 *et seq.*) that, in July, 1900, he noted a ♀ of *Liphyra brassolis* depositing eggs upon a tree in complete possession of the wonderfully interesting green tree-ant, *Œcophylla smaragdina*, which exists in vast numbers in Tasmania, on the coast and mountain scrubs. Upon this tree were several nests of the ants, and several eggs were deposited singly on the tree, on the underside of branches, or protected side of the trunk. Searching the ants' nests for larvæ was unsuccessful, until a half-grown larva was found accidentally, whilst searching an ants' nest for other insects. After this, other larvæ were found, the lozenge-shaped body peculiarly flattened, the head, legs, and claspers, in a groove, the edges of the body closing down tightly all round, except during progression, when the body is raised a little. On one occasion a larva was seen to deliberately seize a half-

grown ant-grub, which, however, was released when the larva was turned over. Even giving them small ants' nests in confinement was not successful, and they had to be returned to the nest in order to feed-up successfully to pupation stage. Dodd's further remarks are to the effect that the larvæ move from nest to nest, that they are so tough-skinned that the mandibles of the ants can make little or no impression upon them, and to protect its head and legs the larva just lowers its sides, and is secure. Although the evidence here offered is sufficient to lead us to accept the fact that the larva lives in ants' nests, it is by no means satisfying that it lives on the grubs of the ants. Green observes (*Ent.*, xxxv., p. 202) that the evidence that they are really carnivorous appears to be proved by the fact that they seized, and attempted to eat, some of the grubs, but he further observes that they do not appear to have been satisfied with that diet, and asks whether it is not possible that their proper food may be some species of Coccid enclosed in the ants' nests. He says that, "in Ceylon, the arboreal nests of this same ant almost invariably include colonies of *Coccidae*, *Aphididae*, and *Aleurodidae*, and adds that there is, in Ceylon, also, a coccidophagous Lycænid larva, *viz.*, that of *Spalgis epius*, which he has, on more than one occasion, found inside nests of another tree-ant, *Cremastogaster dohrni*, feeding upon 'mealy bugs,' *Dactylopius* sp., enclosed therein."

Green communicated his observations on the carnivorous habits of *Spalgis epius* to Nicéville, who published them in his *Butts. of India*, vol. iii., pp. 55-56. He says that *Spalgis epius* has been several times reared from a larva that associates with, and feeds upon, the mealy-bug, *Dactylopius adonidum*. The larva is dull olive-green above, with numerous minute dark bristles and a lateral fringe of brown hairs; beneath pale green, slightly suffused with pink on anterior segments. It partially covers and conceals itself with the mealy secretion from the *Dactylopius*. Independently, Aitken gives (*Journal Bomb. Nat. Hist. Soc.*, viii., pp. 485-487) an account of the carnivorous habits of the same species, a ♀ of which he saw in December, 1891, flying about a bush absolutely infested with "mealy-bug," some of which appeared to be suspiciously large, and which, when the white woolly secretion was brushed off, proved to be Lycænid larvæ. A lateral fringe of bristles, continued round the prothorax, was immediately used by the larva to shovel a quantity of the white stuff on to their backs and clothe their nakedness, after being denuded. They were then seen to be feeding on the mealy-bugs, burying their heads in the down covering them. A number, secured and placed in pill-boxes, fed up on the mealy-bugs, and pupated in due course, and, in a fortnight, imagines of *Spalgis epius* emerged.

In 1891, Holland received (*Psyche*, vi., pp. 201-202) larvæ of *Spalgis s-signata* from Kangwe, on the Ogové River, in West Africa, collected by Good, who found the dark brownish larvæ on the leaves of a *Frangipanni*, the body all covered over with a whitish substance, and which was assumed at once to consist of the remains of plant-lice, with which the undersides of the leaves, on which the larvæ were found, abounded. Suspicion was at once aroused that the caterpillars must have fed upon these white plant-lice, because no leaves appeared to be eaten. The white fluffy substance was readily rubbed off, but there was sufficient left to prove that it was really the remains of the plant-lice,

and Holland says that, "examined under a powerful microscope, this adhering matter is seen to present a peculiar shining appearance, and to thickly cover the hairs with minute granulations, as if each hair had been dipped in some substance like a solution of sugar or salt, and had then been dried." There appears to be no doubt of its aphidivorous habits. Holland further states that he believes *Lachnocnema* and *Euliphyra* to have similar carnivorous habits.

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## CHAPTER XI.

### COLLECTING BUTTERFLY LARVÆ.

The larvæ of some butterflies are, in certain seasons, from the gardener's point of view, too abundant. Such is the case with the larvæ of *Pieris brassicae* and *P. rapae*, which are occasionally sufficiently numerous to do considerable damage to the cabbage crops. The larvæ of *Aglais urticae* and *Vanessa io* are gregarious on nettles, the former usually abundant enough in their thickly populated silk nests, the latter much more irregular in their appearance. Other gregarious larvæ are *Melitaea aurinia* and *M. cinxia*, but, although the black spiny larvæ of the former can usually be taken in the haunts of the species, those of the latter are to be found only in a few places in the Isle of Wight, it having been almost exterminated as a British insect. The larvæ of *Papilio machaon* can only be sought with success in their local haunts in the fens of Cambridgeshire and the Norfolk Broads; and those of *Strymon* (*Thecla*) *pruni* in the woods of Huntingdonshire. In the southern counties, the larvæ of *Gonepteryx rhamni* can be readily found on buckthorn, and those of *Euchloë cardamines* on *Cardamine pratensis* and *Alliaria officinalis.* The larva of *Apatura iris* is confined to sallow in woods, and that of *Limenitis sibylla* to honeysuckle, although these, especially the former, are to be obtained more frequently by beating than by searching. Beating is also pursued for larvæ of *Bithys* (*Zephyrus*) *quercûs* on oak, *Ruralis betulae* on blackthorn, and *Strymon* (*Thecla*) *w-album* on elm. Sweeping at night, with a strong sweep-net, by the grassy sides of woods, hedges, the sheltered hollows of chalk-hill slopes, etc., will produce larvæ of the Satyrids, and occasionally of the Argynnids and Urbicolids, in spite of the fact that the latter live in silken nests, whilst grassy hollows on the mountain-sides will give larvæ of *Erebia aethiops*, and, in its haunts, the local *Melampias epiphron.* We have already dealt with this phase of our subject, at length, in *Practical Hints for the Field Lepidopterist*, in which the collecting work to be carried out each month, for lepidoptera in all stages, is set out at considerable length. The following are suggestions of work that can be done in the various months, in collecting butterfly larvæ, whilst the reader can, by a careful study of the systematic part of our work, especially of the paragraphs "Habits of Larva," etc., gather much more information similar to the following.

FEBRUARY AND MARCH.—The larvæ of *Rumicia* (*Chrysophanus*) *phlaeas* are sometimes very common on *Rumex acetosa* in February and March; they are difficult to see, as their bodies are about the same size as, and

the crimson dorsal line and broader spiracular stripe render them very like, the young curled-up leaves in the centre of the plant.

The hybernating larvæ of *Polyommatus icarus* are sometimes to be found on *Lotus corniculatus*, when searching for cases of *Coleophora discordella*.

In March and April the larvæ of *Aricia* (*Polyommatus*) *astrarche* feed on the undersides of the leaves growing on the young tender shoots of *Helianthemum vulgare*, making marked brown blotches where they feed, and thus betraying their whereabouts; they are fullfed from the middle to the end of May.

Have a plant of *Hippocrepis comosa* ready to place the larvæ of *Plebeius aegon* upon, as soon as they leave their eggs, which they always do either in the last few days of February, or the very first days of March.

The larvæ of *Pararge megaera* are to be obtained, feeding on grasses on the outskirts of woods, by wild hedgesides, etc., in March, the larvæ being fullfed, and pupating, in early May.

April.—In late April, the nearly fullfed larvæ of *Polyommatus icarus* are to be found on *Lotus corniculatus* and *Ononis arvensis*.

The larvæ of *Agriades* (*Polyommatus*) *bellargus* are to be obtained on *Hippocrepis comosa* in April and May; they pupate about the middle of May, and emerge in June.

The very earliest larvæ of *Celastrina* (*Cyaniris*) *argiolus* are to be found just hatched at the end of the month, feeding in the buds or flowers of holly; later, in May and June, they attack the young tender leaves and shoots, upon which they thrive. The larvæ also feed well on young ivy leaves, and on the tender leaves, and young green berries, of *Rhamnus frangula*.

The larval colonies of *Melitaea aurinia* are found, in April and early May, on scabious and honeysuckle, but the eggs always appear to be laid on the former. The larvæ feed up well in confinement on honeysuckle.

In confinement, the larvæ of *Melitaea aurinia* appear to be very susceptible to warmth, collecting in the hottest part of the cage, and becoming lively when the sun is on them. They are much better fed up, however, on a growing plant than in a breeding-cage.

The larvæ of *Melitaea cinxia* are to be obtained in their restricted haunts in the Isle of Wight, towards the end of April; they are gregarious, and hence the capture of one or two at this time usually means the capture of a brood.

The larvæ of Argynnids—*Dryas paphia*, *Argynnis adippe*, *A. aglaia*, *Brenthis euphrosyne*, *B. selene*—should now be sought on various species of *Viola*. They feed in the daytime, but are usually well-hidden.

The larva of *Brenthis selene* feeds on *Viola canina*, appears to have an aversion to the sun's rays, reposing either on the undersides of the leaves, or on the stems shaded by the leaves, selects always the youngest and tenderest leaves until near maturity, eating out large portions of them, and making its whereabouts conspicuous.

The larvæ of *Brenthis euphrosyne*, approaching full-growth in April and early May, are to be found by searching the leaves of *Viola canina* and primrose, where there is much sign of the plants being eaten; they generally hide, and are to be found on the underside of a leaf, but, when the sun is shining, love to bask in it, and are very active, retiring, however, as soon as the sun disappears.

Hedgesides, and the ridings of woods, will give larvæ of *Pararge*

*egeria*, *P. megaera*, *Enodia hyperanthus*, *Epinephele tithonus*, etc., in their respective localities. These are best obtained by sweeping, or searching with a lantern by night. Larvæ of *Melanargia galatea*, *Hipparchia semele*, etc., can similarly be obtained in their known haunts.

The larvæ of *Erebia aethiops* may be collected in abundance at night, with a lantern in the local haunts of this species.

The hybernating larvæ of *Pararge egeria* are to be obtained, in early April, by the sides of the ridings and paths in woods, feeding on grass (*Dactylis glomerata*); the most forward spin up before the end of the month, and the imagines usually appear in May.

The larvæ of *Coenonympha typhon* can be obtained on the moors, in the early spring, on the beaked-rush (*Rhynchospora alba*), on which they slowly feed up, being fullfed in early June.

The larva of *Hipparchia semele* should be swept for, in its known habitats, in April and May, by night, when it comes up to feed; it hides by day, often beneath the surface of the ground.

The young larvæ of *Polygonia c-album* may be sleeved out on hop, stinging-nettle or currant. They must, when they first leave the egg, be fed on quite fresh young leaves, if they are to be reared successfully in confinement.

The young hybernating larva of *Limenitis sibylla* begins to move in early April, moults almost at once, becomes reddish-brown in colour, and spiny, feeds on the fresh bursting honeysuckle-buds, and, by the middle of May, has usually assumed a miniature resemblance to the adult larva.

In the last week of April and early May, search for the larva of *Limenitis sibylla:* it is then in its brown stage, and rests on the brown stem of the honeysuckle just below the green shoot, generally low down on the bush, in a sheltered position. Sometimes the larvæ may be found on the green leaves, where they are much more conspicuous than on the stems.

Young larvæ of *Limenitis sibylla*, reared in confinement, should be fed on young and tender shoots of *Lonicera periclymenum*. They nearly always commence to feed at the top of a shoot, and eat their way downwards, being especially fond of the sun, and always eat greedily when the sun is shining on them.

The young larvæ of *Apatura iris* may be beaten from sallows. The lowest and most unpromising-looking bushes are often the most productive, when working for this species (see *Ent. Record*, vi., pp. 146-147).

In the spring, the larvæ of *Apatura iris* feed up quickly; they eat at night, and rest in the daytime on the midrib of the upperside of a leaf, the head turned towards the base of the leaf. One ought to be able to find them by the leaf hanging down with the weight of the larva; otherwise they are almost undiscoverable.

May.—The larvæ of *Thymelicus acteon* are to be found in May and June, on the sea-slopes from Swanage to Weymouth, feeding on the leaves of *Brachypodium pinnatum*. In confinement, they will eat *Triticum repens* and allied grasses.

The presence of the larva of *Thymelicus acteon* is best told by the wedge-shaped pieces which they eat out of the sides of the blades of *Brachypodium pinnatum*. When such traces are observed, search for

the tubes in which they hide, and which are made by spinning the two edges of a leaf together, so as to enclose themselves therein.

The fullfed larvæ of *Augiades sylvanus* are to be found in early May on *Luzula pilosa*, the edges of a leaf of which are folded over, and lined with silk, to form a puparium, in which the larva changes to a chrysalis.

The larvæ of *Aricia* (*Polyommatus*) *astrarche* var. *salmacis* are to be taken in late May and early June on *Helianthemum vulgare*, in the northern counties of England. From pupæ, formed from larvæ obtained June 3rd, 1877, near Hartlepool, three imagines — apparently *salmacis*, *artaxerxes*, and *astrarche*, on the upperside, but more like *salmacis* on the underside, emerged.

The larvæ of *Aricia* (*Polyommatus*) var. *artaxerxes* are to be found on the undersides of the leaves of *Helianthemum vulgare* throughout May, their colour assimilating remarkably well with that of the underside of the leaves of the foodplant; the larvæ pupate towards the end of the month in a nearly perpendicular position amongst the stems of the *Helianthemum*, and slightly attached thereto by a few silk threads near the ground.

The larvæ of *Strymon* (*Thecla*) *w-album* are sometimes to be obtained in numbers at the end of May, and in early June, by beating elms. Searching is recommended, and an interesting account of this mode of capture is given in *Ent. Rec.*, x., p. 137.

In early May the larvæ of *Melitaea athalia* are to be found on *Melampyrum pratense*, *Plantago major*, and *P. lanceolata*, the first-named foodplant being apparently preferred.

The larvæ of *Limenitis sibylla* are more readily found in May than in April. Look out for freshly-eaten leaves, and then search the stem round, being careful not to overlook the trailing branches. They want close work, being only about half-an-inch in length at the commencement, but almost fullfed at the end, of the month.

Beat sallows through this month for larvæ of *Apatura iris*—sallows that stand high and dry in the middle of a marsh even furnish larvæ —for the ♀ wanders very far in search of sallows, and you never know on what stunted little bush may be feeding the horned head that is so dear a prize.

In May search carefully the terminal buds of a buckthorn bush, *Rhamnus frangula* or *R. catharticus*, for the larvæ of *Gonepteryx rhamni*; several may often be found on one bush.

In late May and throughout June, the flowering stems of *Cardamine pratensis* and *Sisymbrium officinale* should be searched for the young larvæ of *Euchloë cardamines*: they are very like the seed-pods of their foodplants.

In confinement, the larvæ of *Pieris napi* will feed well on horse-radish. They also eat *Nasturtium officinale*, *Barbarea vulgaris*, etc.

Towards the end of the month, plants of *Vicia cracca* and *Lathyrus tuberosus*, growing by hedges or on the borders of woods, should be searched for the young larvæ of *Leptosia sinapis*.

June.—The young larvæ of *Nisoniades tages* are to be found, at the end of June and throughout July, in little hollows, formed by drawing together three leaflets of *Lotus corniculatus*; the two outer ones being drawn close together, and the third one bent over like a curved roof; the structure looks almost exactly like a leaf not quite expanded.

In early June the larvæ of *Adopaea flava* (*thaumas*) are to be swept

from the soft grass, *Holcus lanatus*, with the colour of which their tints assimilate remarkably well; they may also be swept from *Brachypodium sylvaticum*. The larva of this species is often found in one's net, when one is working for micro-lepidoptera among the long grass at dusk, in open places in woods, etc.

When still small, the larvæ of *Cyclopides palaemon* make tubular homes in the leaves of *Brachypodium sylvaticum*, leaving an opening at each end, whence they emerge to feed on those parts of the plant near their domiciles.

In mid-June the young larvæ of *Polyommatus icarus* feed on the leaves of *Lotus corniculatus*, eating into the substance of a leaf either from the upper- or underside, leaving the opposite skin as a white spot, although they sometimes eat the flowers, the petals of which they devour entirely.

The larvæ of *Agriades* (*Polyommatus*) *corydon* are to be found on *Hippocrepis comosa* through June. The larva of this species can only be distinguished from that of *Agriades bellargus* by its having the ground colour of a lighter, brighter green (a green with more yellow in it), and the hairs light brown, whilst that of *P. bellargus* has the ground colour deeper green, with the hairs or bristles black.

The larvæ of *Aricia* (*Polyommatus*) *astrarche* are to be found in late June and July, on the underside of the leaves of *Helianthemum vulgare*. The feeding of the smaller larvæ makes small spots on the upper, dark green, surface of the leaves, the spots becoming larger and browner, until, at last, almost the whole undersurface of the leaves is entirely eaten, although, with an indefinite supply of food, they rarely remain long enough on one leaf to more than blotch it very markedly, before moving to another.

At the end of June and the beginning of July, search the underside of holly leaves for larvæ of *Celastrina* (*Cyaniris*) *argiolus*. The leaves affected have the appearance of being mined.

At the end of June and in early July, the larvæ of *Callophrys rubi* can be beaten from broom, *Genista tinctoria*, and many other plants; bramble, after which the species was named, appears to be very rarely chosen.

The larvæ of *Ruralis* (*Zephyrus*) *betulae* always sit on the underside of a leaf of blackthorn, along the midrib, and are most difficult to see in this position.

The blackthorn bushes are, therefore, better beaten than searched, for larvæ of *Ruralis betulae:* stunted ones are often the more prolific. An umbrella is better than a tray for this purpose, as it can be fitted into the structural irregularities of the blackthorn bushes more successfully.

The low branches of oak, with their growth of foliage, on isolated trees, often prove the best, when one is working for larvæ of *Bithys* (*Zephyrus*) *quercûs*. Search the tray carefully, as the half-grown examples imitate the fallen bud-sheaths exactly in colour.

During the first week of June, beat low elm-trees on the outskirts of woods, or on the borders of rides of woods. Large numbers of larvæ of *Strymon* (*Thecla*) *w-album* may sometimes thus be obtained.

In early June, the eggs of *Hamearis* (*Nemeobius*) *lucina* can be found fairly readily, in the localities where the species occurs, on the underside of primrose (more rarely cowslip) leaves. The young larvæ eat

little holes in the leaves, but later they devour large pieces of the leaves, and their whereabouts become conspicuous.

The young larvæ of *Brenthis selene* usually divide into two sections in this country, one very small part feeding up rapidly and producing a few imagines in August, the others hybernating when about 10mm. long, and going through the winter in this stage.

The fullfed larva of *Argynnis aglaia* is to be found on *Viola canina* in June; it is difficult to discover, and is best obtained when feeding, as its movements are rapid and may attract attention; when not feeding, it usually hides below the leaves of the plant which it has been eating.

The fullfed larvæ of *Dryas paphia* are to be found in early June, feeding on the leaves of *Viola canina*, freely exposing themselves, according to Buckler, on the violet plants.

The larvæ of *Pyrameis cardui* are, in years when an immigration has taken place in May or early June, most abundant, in their little globular homes of spun-together thistle leaves, or other of their food-plants, in late June and early July.

The gregarious larvæ of *Vanessa io* are to be found in considerable companies in late June and early July, spread out over beds of stinging-nettles by roadsides, behind hedges, or sunny corners on the edges of woods.

The gregarious larvæ of *Eugonia polychloros* should be sought on elm, willow, sallow, aspen, etc.; the eggs are laid in spring by hybernated ♀s, and the presence of hybernators in April and early May in a locality should lead to a search for larvæ in June.

The fullfed larvæ of *Hipparchia semele* require light soil, peat, or similar material, in which to burrow. They hide therein by day, feeding by night, and, when mature, form their puparia just beneath the surface of the ground in a manner altogether different from every other British butterfly.

The fullfed larvæ of *Apatura iris* are to be found in June on sallow; they eat rapidly, are easily alarmed, when they draw themselves in, and are difficult to detect on the leaf on which they are. They are usually obtained by beating.

In late June and July, on Wicken Fen, stand over a plant of *Peucedanum palustre*, and look most carefully, if you wish to see the little black larvæ of *Papilio machaon*.

In confinement, the larvæ of *Papilio machaon* will feed very freely on the leaves af garden carrot, on *Angelica sylvestris*, and other umbellifers.

The larvæ of *Colias edusa*, obtained from eggs laid by immigrant ♀s in June, will feed up well in confinement on *Trifolium repens* and *Lotus corniculatus*, pupating in July, the imagines emerging in August.

In late June and early July, the larvæ of *Gonepteryx rhamni* are to be found on *Rhamnus frangula* and *R. catharticus;* stunted bushes in sheltered nooks on the outskirts of a wood are usually good localities for them.

They are sometimes very abundant; and it will add to one's success if one places oneself so that the sun falls across the *Rhamnus* leaf, showing the shadowed side of the larva, when it is at once discovered; otherwise it so exactly resembles the midrib along the centre of the leaf (where it rests) that it will easily escape notice.

The larvæ should be searched for early (especially in a recognised early season) as many of them appear to wander away to pupate.

In late June, carefully search the seedpods of *Cardamine pratensis*, *Sisymbrium officinale*, garden rocket, etc., for larvæ of *Euchloë cardamines*. Particularly examine those where the growth of the seedpod seems irregular, which will be owing to the feeding of the larvæ, and the latter will be found closely imitating the growth there.

Immigrant ♀s of *Pontia daplidice* lay their eggs occasionally, in June, on *Reseda luteola*, on which the larvæ feed in July, producing imagines in August or September. The species is quite unable to winter in our climate.]

In June (and August) the larvæ of *Pieris napi* may sometimes be found in numbers feeding on *Nasturtium officinale* and *Barbarea vulgaris*. They may also be found on *Hesperis matronalis*, etc. They grow very rapidly, and are fullfed in early July, pupating during that month, and emerging towards the end of July or in early August.

July.—In July, the larvæ of *Nisoniades tages*, no longer able to hide within the little caves formed of the leaflets of *Lotus corniculatus*, which they use when young, make longer ones, but their feeding soon exposes their bodies partly to view. They repeatedly change their habitations, always, however, by night, and are most retired in their habits. They are fullfed at the end of the month, when they spin silken hybernacula, in which they remain invisible, not pupating until the following April or May.

The young larvæ of *Hesperia malvae* are to be obtained, in July, on *Potentilla fragariastrum*, *P. reptans* and *Rubus fruticosus*; the larvæ that are on bramble seem to be found chiefly on stunted bushes with small leaves; the large juicy leaves of strong bushes apparently offer no temptation to the female.

The larvæ of *H. malvae* appear to choose the upper side of a leaf on which to rest, and, stretched along the midrib, spin several silken threads overhead for a covering, feeding therein by eating away the upper part of the leaf. When a larva has cleared this, and made a blotch of considerable extent, it repeats the work on another leaf. The larger larvæ pull down a second leaf over the first, fastening the edges with silk, and these form a hollow in which they live, coming out therefrom occasionally to feed on the surrounding leaves.

In July, the young larvæ of *Augiades sylvanus* feed on cock's-foot-grass, couch-grass, etc., resting in the middle of a blade and fastening its edges across with five or six distinct little ropes of white silk.

The young larvæ of *Adopaea flava* (*thaumas*) leave the eggs in late July or early August, and spin little silken ropes across the blades of grass; but, although they feed until November before hybernation, they are not then more than about 2mm.-3mm. in length, almost the whole of the growth being done in the spring (Hellins).

In the early part of July, collect the flower-heads of *Anthyllis vulneraria* for larvæ of *Cupido minima*. They eat little holes through the calyx and corolla so as to get into the flowers, when they feed on the immature seed-vessels, leaving one floweret when cleared and entering another. As they get older, their bodies cannot be wholly contained in the corolla, and they may be then seen with the fronts of their bodies thrust into the flowers, the hinder parts hanging out, but

still difficult to distinguish among the dense inflorescence of the flower-head.

In confinement the larvæ of *Cupido minima* are fullfed before the end of July; they then take up a position as if for pupation, but remain quite still and immovable until the following May, when pupation takes place.

In July, the little larvæ of *Polyommatus icarus* make small, pale, transparent blotches, on the leaflets of *Lotus corniculatus*, *Ornithopus perpusillus*, etc., the paleness being due to the eating away of the soft part of the leaf, and leaving only the transparent skin. In late July the now nearly fullfed larvæ may be more easily found.

When fullfed the larva of *Argynnis aglaia* will spin together several of the large leaves of its foodplant into a hollow, tent-like enclosure, and, in this, suspend itself before changing into a chrysalis.

The larvæ of *Dryas paphia* leave the egg towards the end of July, the egg-stage only lasting about a fortnight, the larvæ feeding very little (or not at all) on *Viola canina*, before hybernation, being only about 3mm. long in spring (March) when they commence to feed.

The larvæ of *Pyrameis atalanta* are to be found in July and August in little chambers, formed by drawing together the leaves of *Urtica dioica* and *Parietaria officinalis*; they generally hang up and pupate within these larval chambers.

In July, the larvæ of *Pyrameis cardui* fasten together the leaves of *Onopordon acanthium* and other thistles, with a few tough silken threads, eating out the thick fleshy parts of the enclosed leaves. They generally hang up and pupate within these larval chambers. (Larvæ also feed on *Echium vulgare*, *Malva*, etc.)

The young larvæ of *Apatura iris* are not difficult to rear in leno-sleeves on a healthy sallow-bush; the eggs are laid from about July 20th-August 10th, and the egg-stage lasts only about eight days.

The young larvæ of *Melampias epiphron* are not easy to rear in confinement; they feed on *Aira praecox* and *A. caespitosa*, growing to the length of about ½in. before winter; they then hybernate until the end of February, when their food-plant should be attended to.

The larvæ of *Coenonympha tiphon* may be reared in confinement on the beaked rush, *Rhynchospora alba*; a plant of this should be carefully potted, and the young larvæ may then be left without much attention; they go on feeding, as a rule, until the hybernating stage, with little trouble, provided that care be taken not to allow the active little fellows to escape.

The larvæ of *Euchloë cardamines* are to be found, in July, on many cruciferous plants, of which *Hesperis matronalis*, *Sinapis arvensis*, *Cardamine pratensis*, *Sisymbrium officinale*, *Alliaria officinalis*, *Turritis glabra*, and, in gardens, garden-rocket and horse-radish appear to be the most frequently selected.

The larvæ from the eggs laid by the summer ♀s of *Leptosia sinapis* will feed up on *Vicia cracca* or *Orobus tuberosus*, and are generally fullfed in early September.

In July, the young larvæ of *Papilio machaon* may be searched for with every prospect of success, the black larva, with its white saddle, being very easily found when once the eye of the searcher is in. Until then, it is most difficult to detect, although many may be on the

plant under examination. The habit of repose, with the neck arched something like the larva of a Sphingid, is very striking.

August.—In August, the larvæ of *Cyclopides palaemon* feed within long cylindrical tubes made of the leaves of *Brachypodium sylvaticum*, quickly, however, eating out their domiciles and forming fresh ones; they first eat the lower part of the leaf below the tube, all but the midrib, then devour the top of the leaf above the tubular part, and, lastly, the tube itself, until, by degrees, it becomes too short to shelter them, when they desert it and cut through the midrib, causing the tubular remains to fall away, after which they select a fresh leaf for the construction of another tube, as above.

The young larvæ of *Celastrina argiolus* are to be found feeding on the tender young ivy leaves and flowers, and pupate in early September. The eggs are usually laid in early August, beneath the flower-heads of the umbels of ivy.

The newly-hatched larvæ of *Colias hyale* feed up slowly from about mid-August, until about October or November, on *Trifolium repens*, *Medicago lupulina*, *M. sativa*, etc. They then hybernate till March, and will usually pass this period successfully, provided that they are not exposed to a really low temperature, are kept quite clear of decaying leaves, and have a perfectly dry spot to rest on. They must be supplied with fresh food very early in the spring, and should be given as much sun and air as possible, but not exposed now to a low temperature.

The larvæ of *Colias edusa*, obtained from eggs laid by ♀ s captured in August and September, will feed up well in confinement on *Trifolium repens* and *Lotus corniculatus*. They will try to feed up the same year, and must be carefully nurtured. They might, indoors, be induced to partially hybernate until early March, but then would have to be kept perfectly free from damp, and well away from any decaying leaves of their foodplant.

The larvæ of *Epinephele tithonus* appear after the eggs have been laid about three weeks, and feed well on *Poa annua*, *Dactylis glomerata*, and other common grasses; they hybernate when exceedingly small, but nibble in winter when the weather is mild, not feeding very much, however, till mid-March.

The young larvæ of *Melanargia galathea* leave the eggs in August, and feed well, in confinement, on almost all the common garden grasses—*Dactylis glomerata* has been noted as a specially favoured one. The larvæ hybernate from about the end of October, feeding occasionally when the weather is mild, going ahead more rapidly in March and April, and being fullfed in June.

The larvæ of *Hipparchia semele* can be reared in confinement on *Triticum repens*, *Aira praecox*, and many other grasses; they are very sluggish, hide low down among the foodplant, nibble slowly most of the winter, feed only at night, and often bore under the ground, if at all suitable, by day. They are fullfed about mid-June, when pupation takes place.

The fullfed larvæ of *Papilio machaon* are to be found in August, usually resting in an almost vertical position on a stem of the food-plant, or on a plant near; although such a large conspicuous caterpillar, when separated from its food, it is not at all easy to see when

surrounded by the herbage of the fen districts to which it is almost absolutely restricted in Britain.

SEPTEMBER.—The young larvæ of *Polyommatus icarus* make little, pale, transparent blotches on the leaflets of *Lotus corniculatus*, *Ornithopus perpusillus*, etc., the paleness being due to the eating away of the soft parts of the leaf, and leaving only the transparent skin. Still more common in July.

Sleeve larvæ of *Apatura iris* out on sallow, so that they can rest on a thick branch; they must be removed from the sleeves every day, till they settle down on a twig, as none ever hybernate successfully if left on the sleeve.

Larvæ of *Pyrameis cardui* and *P. atalanta*, found in September and October, will pupate and emerge the same year; they must, therefore, be kept under artificial conditions, and care taken of them, both as regards temperature and food, to ensure success. The species will not hybernate as larvæ or pupæ under any conditions.

The larvæ of *Pararge egeria* can be reared, in confinement, on *Dactylis glomerata*, etc.; they appear to nibble throughout the winter, and to pupate as soon as there is any mild weather in the spring, often at the commencement of April (sometimes this species passes the winter as pupa).

The young larvæ of *Colias hyale* (obtained from eggs laid by confining ♀s on clover plants, exposed to the sun), feed slowly the end of October, when they become dormant and hybernate. In confinement, they do this best by removal from the foodplant, and by being placed in a chip-box covered with muslin; they must be protected from frost, and kept at a temperature of about 40°F.-45°F. By the middle of February, the larvæ are again on the move, and should then be placed on growing plants of clover, with plenty of young leaves, when they will commence to feed again. They feed on slowly through March and April, pupate in May, and the imagines emerge in about a month.

OCTOBER.—In October, the larva of *Cyclopides palaemon* draws a leaf of *Brachypodium sylvaticum* into tubular form around itself, lining the inside carefully with white silk, and thus forms the hybernaculum, in which it spends the winter.

In late October and November, the hybernating larvæ of *Augiades sylvanus*, about 12mm. long, are to be found in their long, silken, narrow, tough, close-fitting hybernacula, formed by spinning together the edges of the green blades, the opaque webs being not much bigger than the larvæ; in confinement, riband-grass forms a useful substitute for the finer grasses; the larvæ commence feeding again in March, and are fullfed about the end of May.

Small larvæ of *Polyommatus bellargus* are to be found in October (and July) on the underside of the leaves of *Hippocrepis comosa*, eating out the undersurface for a small space, but leaving the upper skin untouched, which then turns white; these little white dots or spots show, therefore, where the larvæ are at work; they feed slowly through the winter, and the blotches are much larger by early February. In March, the leaflets are eaten from the edge, and often demolished entirely.

The hybernaculum, in which the larva of *Limenitis sibylla* passes the winter, may be placed three or four buds down from the tip of the

twig, shooting out from the main stalk of a large honeysuckle-bine; it is made of a honeysuckle leaf, which has been first partly bitten through near its axil, and then securely fixed by its two edges, for about half its length, to the twig from which it grows, and across which its edges are firmly bound together with a spinning of strong silk; just at the point where the leaf meets the underside of the twig, there is a circular aperture, apparently designed for the egress of the larva in spring; as the leaf withers the hybernaculum becomes puckered, and little more than half-an-inch in length, and has the appearance of a small shrivelled leaf, clinging to the dry stem, and would thus easily escape ordinary observation.

The larvæ of *Erebia aethiops* commence to hybernate in October, when exceedingly small, hiding in the thickest parts of the tufts of grass with which they may be supplied. They commence to feed again in early spring, as soon as the grass commences to grow, and are fullfed in May and June.

The larvæ of *Hipparchia semele* hybernate small, remaining on the grass all the winter, and show no tendency to burrow or hide; they feed a little all the winter in suitable weather, but do not grow perceptibly till the spring.

The larvæ of *Enodia hyperanthus*, *Epinephele ianira*, *Coenonympha pamphilus*, etc., require considerable attention in confinement during the winter; they appear to nibble occasionally, during mild weather, from November to March, growing very slowly, or not at all, but making good progress later. *Enodia hyperanthus*, in particular, appears to hide as much as possible from the daylight during the hybernating period.

These "hints," as to obtaining eggs of butterflies, are extracted from our work *Practical Hints for the Field Lepidopterist*, and are inserted as illustrations of the various details to which the attention of the seeker for, and breeder of, the larvæ of butterflies must be directed.

## CHAPTER XII.

### THE SILK-SPINNING HABIT IN BUTTERFLY LARVÆ.

The silk-spinning habit is common to almost all lepidopterous larvæ. The larval spinneret appears to be homologous with the hypopharynx of insects of other orders. The homology of the different parts, Packard says, is apparently identical, the common duct of the silk-glands or sericteries opening at the end of the hypopharynx, which here forms a complete tube, or proboscis, extending beyond the end of the labium, and being then modified into the spinneret in adaptation to its use as a spinning organ. The silk thread which issues from the spinneret was discovered by Leeuwenhoeck to consist of a double ribbon-like band, due to the silk-glands each forming a cylindrical thread of silk, surrounded by a layer of gum; the two threads having passed into the common duct receive the secretion of Filippi's gland, where the silken fluid is formed, and, passing into the common canal, enter the orifice of the spinning canal, almost completely divided into two by the sharp

edge of the rachis. The threads each pass into one of the two grooves surrounded by gum, and are pressed by the powerful contractions of the muscles of the plates, so that each is compelled to mould itself in the groove it occupies, and to take its shape. The spinneret thus compresses the thread and diminishes its diameter, whilst the constant compression of the thread as it passes through the press keeps it in a certain state of tension so as to allow the caterpillar, while spinning, to firmly hold its thread; the press does not act directly on the silken thread, but through the gummy layer which transmits over the whole surface of the silken fluid the pressure exerted on it. After having overcome this difficult passage, the silk thread has acquired its definite form and passes out of the spinneret. [Full details of the structure of the spinning organs, the formation of silk, the drawing of the thread from the spinneret, etc., are to be obtained from Packard's *Textbook of Entomology*, pp. 339 *et seq.*] These preliminary details will perhaps enable the young lepidopterist to understand some of the observations he is certain to make when watching the larvæ of butterflies, for the silk-spinning habit is to be observed in a greater or less degree in all butterfly larvæ.

It is remarkable how variable in degree is the silk-spinning habit developed in the larvæ of different butterflies. Usually, but not at all necessarily, the larvæ of allied butterflies have a somewhat similar habit in this respect, *e.g.*, the larvæ of most Ruralids, and many Pierids, spin very little silk, whilst those of others spin much. The larvæ of certain Vanessids, Melitæids, etc., spin threads wherever they walk, being apparently unable to move about in their early stages, at least, without so spinning. All larvæ, however, whatever be their general habit, spin a silken web on which to fix themselves during the period of moulting, the old larval skin being attached thereto before the larva in its new dress withdraws itself therefrom. Some larvæ construct nests in common, and live gregariously, especially when young, others fold up one or more leaves with silk, and live in the hollow thus constructed singly; others live quite exposed, resting on a leaf, stem, or other part of the foodplant, and, at the most, spinning a few silken threads as a pad on which to stand.

As a rule, butterfly larvæ live an exposed life. Of those that hide, however, in the fashion of so many other lepidopterous larvæ, by making a tent of one or more leaves in which to secrete themselves, the Urbicolid larvæ are the most remarkable. All our British species do this, as will be seen by reference to our notes on the "habits of the larvæ" (*posteà*, pp. 98, 108, 120, etc.), and the habit is common to the superfamily. There is no need to redescribe the habits of our British species in this respect, but we may note that Scudder, speaking of the American species, says that "the 'skipper' larvæ form a nest of a single leaf, in early life, folding over a little piece of leaf, and fastening the edge to the opposite surface by a few loose strands of silk; to effect this, they first bite a little channel into the leaf, at just such a place as to leave a fragment of leaf, neither too large, nor too small, to serve as a roof when they shall have turned it over; often they have to cut two channels in order to procure a flap sufficiently small for their purpose; and it is curious to watch one of these tender creatures, just as soon as it has devoured its eggshell, struggling with a tough oak-leaf, to build

for itself a house. These nests are usually very firmly made, the silken fastenings being composed of many strands, often very tough. On leaving one nest to construct a larger one, the caterpillar always appears to first bite off the threads of the old nest, and thus give the flap a chance to resume its position, which, however, it rarely fully does. When older, many of these same 'skipper' larvæ find a single leaf of their foodplant too small to conceal them, and so they draw several leaves together, just as they grow upon the plant, and, retaining them in the desired place by silken bands, the larvæ live within the silken bower. This mode of construction is adopted almost from the first by the Pamphilids, which feed on grasses, the proximity of adjoining blades near the base affording a good chance to attach them together, while a cluster of blades furnishes a similar chance to construct the somewhat tubular nest they require when they have grown large and fat." As to the value of these homes, Nicéville observes (*Butts. of Sumatra*, p. 394) that the larva of a large "skipper" butterfly, *Hidari irava*, and that of a Nymphalid, *Amathusia phidippus*, live, at the same time, on the leaves of *Cocos nucifera*, and he remarks that, owing to their general abundance, the two species often have a severe struggle to live together, in which the more robust Hesperiid, which secures a shelter for itself by spinning the leaves together, is generally victorious. Even among the Papilios, the larvæ do not disdain to use this mode of protection, and whilst that of *Jasoniades glaucus* merely spins silk on the surface of the leaf on which it rests, so that the edges of the leaf curl up and conceal its sides, the larva of *Euphoeades troïlus* spins the leaf completely over, so that the opposite edges touch, and itself thus becomes quite hidden.

The purpose of gregarious nests appears to be twofold. In one case, *e.g.*, that represented by *Aporia crataegi*, the nest is very definitely intended for the purpose of concealment; in the other case, *e.g.*, that represented by *Euvanessa antiopa* and *Aglais urticae*, the silken web appears, especially after the larvæ have reached the second stadium, to be merely a means of keeping up a connection between the various parts of the gregarious company, and to be little used for the purpose of hiding. Scudder, referring to the larvæ of *Euvanessa antiopa*, notes that "they move about from place to place, spinning wherever they go, so that, at last, the line of movement, by successive strands thrown across every angle that a twig makes with the larger stem, forms a sort of veil of silk over which they crawl with extreme rapidity, but without which their movements are greatly retarded." Although our single British Apaturid species has a solitary larva, those of one of the American species, *Chlorippe clyton*, are gregarious in their first three stadia, and use their web much in the same manner as that just described as usual for *Euvanessa antiopa*. They feed side by side in rows, eating the leaves from the tips backward, but leaving the stouter ribs; they form a pathway of silk wherever they go, but make no special structures for concealment. The larvæ of the allied *C. celtis* lives solitarily, but lines the upper surface of a leaf of *Celtis* with silk in such a manner as to cause the sides to curl slightly upward, and thus partially conceal it from view. Similarly, the larva of *Anaca andrica* lines the upper surface of *Croton* with silk, bringing the upper edges together without fastenings, and thus makes a nest like that of *Euphoeades* (*troilus*), within which it lies concealed, eating the base of

the leaf; when this becomes too small, it makes a similar nest from another leaf, but goes outside to feed on neighbouring leaves, generally towards evening.

The tiny larvæ of *Aporia crataegi*, spin a web over two or three leaves of their foodplant, within which they hide, coming out only to feed, and extending their web as they increase in size. A specially tough retreat is built for a hybernaculum, and, in this, a whole community winters in safety. Our other Pierid larvæ spin threads of silk on which to walk, but, otherwise, none of the allies of *A. crataegi*, in Europe, spin similar webs. Scudder, however, notes that a Mexican Pierid constructs a web nearly as close as parchment.

Belonging to an entirely different group of butterflies, but having almost exactly the same gregarious habit as *Aporia crataegi*, the larvæ of *Melitaea aurinia* spin a silken tent over the young leaves of scabious, in which they live, feeding only on the undersides of the leaves; they feed very slowly, and are still exceedingly small when they make their hybernaculum, after leaving which, in the spring, they appear to live singly and fully exposed, making, however, a silken cocoon by drawing together several culms of grass, when fullfed, in which they pupate. The larvæ of *M. aurinia* are said to leave their hybernacula very regularly, about March 1st in Co. Cork, in Ireland, although, in the early season of 1893, they had already done so in mid-February. The larvæ of *M. cinxia* similarly pass their early lives and the winter gregariously in a tent formed by a compact web, leaving its shelter in the spring for another slighter structure. The hybernating web is larger than that under which they feed, and is woven of silk, with grass and plantain stems intermixed, and is well-roofed, so that the inner grass is quite dry. Luff says that, in Guernsey, he had noticed the very young larvæ of *M. cinxia* on the webs, spun on their foodplant, in August and September, but that, when he searched for their hybernacula in December and January, in the same spot, he could not find them until he came accidentally across a winter-nest whilst searching for beetles; this was in the centre of a tuft of grass, close to the roots; it was pear-shaped, and, with the larvæ of *M. cinxia* were a number of larvæ of *Anthrocera trifolii*, hybernating with them. Luff says that they spin another web in spring on their foodplant, but this is less compact than the winter-nest, although larger. Most of the larvæ leave the nest and live singly, when nearly fullgrown, others, however, live more or less gregariously, even up to the time of pupation. This mode of life is evidently not confined to the Melitæids of the Old World, "for Scudder notes a similar habit in some of the Melitæids (*Cinclidia*, *Euphydryas*, etc.) of North America, which, living in company, cover at first a few leaves, then the whole head of the plant, and eventually, sometimes, the whole plant, in a tolerably firm web, within which the company feed, until the whole becomes a nasty mess of half-eaten and dying leaves, and all sorts of frass, including their own excrement and cast-off pellicles, everywhere tangled with web. Within such a nest they hybernate, but not until they have strengthened it with denser web, and drawn the leaves of the head more tightly, so that it becomes a mere bunch which one may cover with his hand, and which contracts the more apparently as winter approaches. In the spring, they evidently have had enough of this sort of communal life, and live, thereafter, in the open air." He further notes that, whilst the larvæ of *Euphydryas phaeton* hybernate

as thus described within a web on *Chelone glabra*, those of *Cinclidia harrisii*, on *Aster umbellatus*, live similarly until the time for hybernation, when they desert the nest and conceal themselves in crevices, where they pass the winter.

The gregarious character exhibited by such Melitæid larvæ as those just mentioned, is almost paralleled by that of certain Vanessid larvæ to which, already, reference has been made. But the less gregarious species among the Vanessids also spin hiding-places, usually several on one plant, but only one larva in each little nest. Of these, the spun-together thistle-leaf (or leaves) that often forms the hiding-place of the larva of *Pyrameis cardui*, and the spun-together nettle-leaves that similarly form the home of the larva of *Pyrameis atalanta*, will be known to everyone. Scudder, writing of these, says that "the most common form of nest is that in which different parts of the same leaf, or adjacent parts of different leaves, are fastened together by silken strands. The simplest and weakest of these are made by the caterpillars of *Polygonia faunus* and *Vanessa* (*Pyrameis*) *atalanta*, which fasten together very weakly the opposite edges of a single large leaf, so as just to make them meet; but the threads are so slight that they are ruptured with the slightest effort. The caterpillar within, having thus secured a shelter, seems loth to leave it, and makes its meals from its own dwelling, until, having literally eaten itself out of house and home, it is forced to venture forth and construct another. When, however, *V. atalanta* is more than halfgrown, it finds it easier to attach neighbouring leaves of the thickly-growing nettle, than to find one sufficiently free to use it only, so that fully one-half of the nests of the larger caterpillars are made from a number of leaves; the nest is always roomy, capable of housing several caterpillars, though never containing more than one. The nesting-habits of *V. atalanta* are shared by the other species of *Vanessa* with certain slight variations. In early life, *V. cardui* tries to make the stiff and crenulated edges of thistle-leaves meet together, but with indifferent success, and so fills in the interstices with an exceedingly thin web, in no way concealing it from sight. In after life it forms an oval nest of the size of a pigeon's egg, by fastening adjoining leaves together very slightly, and filling all the interstices with a similar flimsy web, upon which it fastens, or into which it weaves, bits of eaten leaf, or parts of the inflorescence of the plant, still imperfectly concealing it from sight; and, sometimes, it hangs itself up for chrysalis within the same narrow, and by this time very filthy, apartment. *V. huntera* makes a similar, but rounder, nest on the *Gnaphalium*, and conceals itself very effectually by completely covering the more compact, but still very slight, web, with the inflorescence of the plant. At first this is merely composed of the silky hairs of the foodplant, mixed with much silk, forming a dense white mat, beneath which they devour the parenchyma, then enlarge the nest, never leaving it for food, but enclosing larger and larger areas, until, finally, many leaves are drawn together, the bitten-off inflorescence of the *Gnaphalium* interwoven with the web, and a nest formed as large as a pigeon's egg, only in the last few days of their life do the larvæ leave the nest and devour the entire leaf."

The hybernating period is a serious one for those silk-spinning larvæ that hybernate as larvæ. *Limenitis sibylla* for its hybernaculum, spins a honeysuckle leaf to a twig of the plant, which it securely fixes,

and prevents from falling, by silk spun over its extremity and the twig on which it grows. The leaf is then spun carefully together and becomes crumpled as it dries during the winter. Into this the larva crawls, and, in this, it hides during the period of hybernation. So firmly is the hybernaculum fixed to the twig, that it can have no independent movement, and it resembles so exactly a dead leaf clinging to the stem, that it is sure to escape observation. When *Apatura iris* spins its hybernaculum, it not only covers the twig with a silken pad, to which it may firmly cling, but also envelopes the hinder part of its body in a silken covering. The hybernaculum of the larva of *Basilarchia archippus* appears to be as interesting. Scudder says that the larva hybernates when partly grown, and provides for the occasion a winter residence, which is occupied only during the cold season. For this purpose, it eats the side of a willow-leaf nearly to the midrib, for about one-third the distance from the tip, ordinarily selecting for the purpose, a leaf near the end of a twig; it brings together the opposite edges of the leaf, and not only fastens them firmly with silk, but covers this nest outside and inside with a carpet of light-brown, glossy silk, so that the leaf is nearly hidden, nor is this all, it travels back and forth on the leafstalk and around the twig, spinning its silk as it goes, until the leaf is firmly attached to the stalk, and, in spite of the frost and wind, it will easily hang until spring. Following the projecting midrib, the caterpillar creeps into this dark cell, head foremost, and closes the opening with its hinder segments, all abristle with spines and warts. The other species of the same genus, *B. arthemis* and *B. astyanax* have similar habits, the former feeds on birch, and, if one examines these trees in early spring, one can hardly fail to be struck by the deceptive resemblance that these hybernacula bear to the opening buds and curving terminal shoots of the very twigs on which they occur; the colour of the soft down of the buds, and the enveloping silk of the hybernacula are as similar as are their forms, and this mimetic resemblance is doubtless as effective as it is interesting. The larva of *B. arthemis* spins its hybernaculum when about half-grown, and, selecting a growing leaf of birch, it eats away the apical third or fourth, excepting the midrib and a narrow flange on each side of it, or it uses the leaf it has been eating, already trimmed in this fashion; it then draws together, above, the outer edges of the uneaten portion to construct a tube, which it lines very heavily with brown silk, within and without, and further binds the leafstalk to the stem with repeated bindings of silk to prevent its falling to the ground in winter; by means of the ledge formed by the projecting midrib, it then enters the tube head foremost, and completely fills it, so that the opening is just closed by the roughened end of the body.

Although nothing to do with the silk-spinning of the hybernaculum, we may here mention the peculiar habit of *Basilarchia arthemis*, of retiring, after a meal (made of a birch leaf), to the stripped midrib to rest, fastening to it, however, minute bits of leaf with an abundance of silk in order to strengthen it, whilst Chapman describes the much more complicated silk-covered platform, made by the larva of *Charaxes jasius*, and which, in the Esterel, it spins on the south side of an *Arbutus* tree, low enough down to have the upper part of the tree as a protection and shelter. The larva either clothes the surface of a leaf with silk, or fastens together several leaves, which it then similarly covers with

silk, and on which it obtains a firm foothold, resting thereon the greater part of the day, basking in the sun, the leaves being usually at such a slope that they get an almost vertical exposure, whilst to feed they often prefer to go to a neighbouring spray, so as not to interfere with their carefully prepared resting-platform. Of the protective value of this particular resting-position, Chapman says (*Ent. Rec.*, ix., p. 193): "The larva at rest, seen from whatever direction, exactly imitates some aspect of leaves or buds under the different effects of light and shade, and it is thus possible for an untrained eye, in many instances, to look at it, and for it, some time before seeing it. The yellow lateral line resembles the midrib of the leaf seen from above or below, according to light; the colour and apparent texture of the skin are the same as those of many leaves. The extraordinary head, with its coloured jaws and spines, suggests, in many aspects, the little group of buds at the extremity of the branches. One has often to look a second time at certain leaves and branches, as well as at the buds, to be sure that they are parts of the tree and not a larva. The curiously-coloured circles on the back of the abdominal segments 3 and 5, which are more brilliant with their blue and yellow than anything in an *Arbutus* leaf, nevertheless produce exactly the effect of certain little rings of fungus, or decay, that are very common on the leaves." But the larva of *Basilarchia arthemis* is said, by Scudder, to further use its silk-spinning habits for protective purposes in a most remarkable way, for he says that the young larva makes a loose ball about the size of a small pea, out of bitten scraps of leaf held together by strands of silk, and this it attaches by a thread to the stripped midrib, on which it is resting, as described above, so that it is moved by every breath of wind, a device, perhaps, to distract from itself the attention of an enemy, for, by constant removals, it is always kept close to the eaten edge of the leaf, while the posterior of the larva is as far out on the stripped midrib as it can find a good footing; after the second moult it no longer makes this remarkable little packet.

Although less usual among butterfly larvæ, some species use the means of escape that is so frequent among the larvæ of certain groups of moths, *viz.*, when disturbed, of allowing themselves to drop rapidly from their position of rest by a silken thread attached to a leaf. Such among our British species are *Chrysophanus dispar*, *Hesperia malvae*, etc., and Scudder observes that, in America, *Strymon titus* and *Hypatus bachmanii* have the same habit. It is certainly more frequently observed among young, than in older, larvæ.

The final stage usually brings out the silk-spinning possibilities of the larva to their greatest extent. For the purpose of pupation, almost all butterfly larvæ, however little silk-spinning they do during their larval life, do some spinning at this period. Few, except the Urbicolids and Parnassiids, spin silken cocoons, *i.e.*, silken webs in which to pupate, but almost all spin at least a thick silken pad to which the pupa is attached by its anal cremastral hooks, and many spin, in addition, a silken girth, or support, round the body, which acts as a girdle when pupation takes place. There are, however, many intermediate stages between the coarse, but slight, silken cocoon of the Parnassiids, in which the pupa lies loosely, and the merely suspended butterfly pupa, whose larva has spun a silken pad before pupation, and from which it

hangs freely in order to change to the pupal state. Some of the most interesting of the puparia spun by butterfly larvæ are those of certain Vanessids, Argynnids, and Melitæids. Among the former, one may note the large open umbrella-like puparium of *Pyrameis atalanta*, formed by the larva spinning nettle-leaves together, yet quite open beneath, in order to facilitate the escape of the imago. There is also the often almost globular silken puparium spun by the larva of *P. cardui*, and a somewhat similar one spun low down, near the ground, by the larva of *Argynnis aglaia*. Many of the Melitæids, too, spin silken puparia, and the larvæ of *Melitaea cinxia*, when fullfed, do not always lose altogether the gregarious habits of their younger stages. We have noted (*Ent. Rec.*, iv., p. 169) that, on one occasion, three larvæ of this species had spun a common silk tent, in which they had changed to pupæ. It is quite common to find a number of larvæ of this species spun up for pupation in close proximity to each other. Newman says, dozens of chrysalids are often suspended to the plantain almost close to the ground, in company. The larva of *M. aurinia* pupates alone, spinning a large quantity of loose, flossy silk, from which it suspends itself for pupation.

We have already noted (*anteà*, p. 53) on the gregariousness of certain Pierid larvæ, and the nests spun by *Aporia crataegi*, and the Mexican species, *Eucheira socialis*. A note by Anderson and Spry (*Victorian Butterflies*, pp. 36-37) on another Pierid, *Delias harpalyce*, whose larva feeds on a species of mistletoe (*Loranthus pendulus*), suggests that the web spun by the gregarious larvæ of this species is more or less utilised as a basis for the pupation pad. They write: "The larvæ, after the second moult, spin a silken footing for themselves wherever they go, and these spinnings, from so many larvæ feeding gregariously, form, eventually, quite a web-like habitation, which, no doubt, is of great service in enabling the caterpillars to maintain their footing during high winds or storms. When fullfed, they spin more than ever, and then, attaching themselves to the web, turn into pupæ." Floersheim, however, particularly insists (*Ent. Rec.*, xvii., pp. 310-311) that the larval habitations of *Pyrameis atalanta* are not, as often stated, used as puparia, but that the pupa, as noted above, is attached to the underside of a kind of umbrella, formed by drawing nettle-leaves together, and quite open beneath; this kind of puparium is what we know. We opened a great number at Val Tournanche in August, 1905, each containing a pupa.

The belief that the silk-spinning habit of certain larvæ is sometimes utilised in forming protective homes against adverse weather conditions—particularly of wind and rain—and this not only in the direction of making puparia, but also in earlier larval life, has often been expressed, and it is possible that this idea is well-founded, *e.g.*, the silk-spinning habits of the larvæ of *Eugonia polychloros* are almost identical with those of *Euvanessa antiopa*, both tree-feeding species, and are apparently entirely different from those of *Aglais urticae*, *Vanessa io*, etc., allied species feeding on low plants, the silken habitation made by the larvæ of the two first-named species being much more extensive and permanent than in the case of the two last-named. Do these more extensive webs give a greater degree of safety on trees? Chapman observes that "the young larvæ of *Eugonia polychloros* and *Euvanessa antiopa* cover their eggs, and the neighbourhood where they were deposited, with a silken web, not spun, as it were, of set

purpose, but the result of journeying to the nearest leaves to feed and returning to the central position for resting. They appear often to feed in turns, one lot going out to feed whilst others have just returned to rest. As they get larger they move their headquarters, again, apparently, according to such exigencies as may occur, from the form of the branch they are on, to make another position more central to the available food, than to any instinct that makes them move at any particular stage or instar. Different broods seem to vary a good deal as to how far they remain gregarious in the last instar or become quite solitary. If food remains at hand, few larvæ wander far off until they do so for pupation, but they cease to go to and fro so much, and so, though still spinning silk to walk upon, do not increase the considerable webs spun during the earlier stages. Essentially, perhaps, *Vanessa io* and *Aglais urticae* do the same as *Euvanessa antiopa* and *Eugonia polychloros*, but the abundant web they spin in their earliest instars is but slightly added to (comparatively) in the intermediate stage, and, in the final instar, gregariousness seems to have ceased. *Aglais urticae* has a habit very similar to that of *Pyrameis atalanta*, of forming a leaf into a pocket. It brings the opposite edges together of one leaf only, it never, so far as I have observed, uses more than one, and, like *P. atalanta*, it eats the terminal half of the leaf, destroying the domicile. The number of caterpillars of *A. urticae* that make this tent is only a small proportion of each brood, probably it is made for the safety of the larva during the last moult, as they are always occupied by nearly full-grown larvæ." These remarks are highly suggestive that the maintenance of the gregarious habit, and the continuance of the use of, and extension of, and even moving of, the silken home of the tree-feeding species, are of advantage to them, and there is no advantage so distinct that occurs to one as the comparative security such a home offers during storms of wind and rain, when willow-trees are badly bent, and the chance of destruction to large larvæ with no special means of retaining a firm foothold, becomes very great indeed. Trouvelot's account (*Proc. Bos. Soc. Nat. Hist.*, xii., p. 92) of the way that the larva of *Jasoniades glaucus* makes itself safe during rain-storms, has been repeatedly quoted. He says: "Every one knows that the larva of this species, when at rest, remains upon the middle of the upper part of a leaf; for this purpose a carpet of silk is spread upon the leaf by the larva. This leaf, by means of the silk, is made to curve a little. On one rainy morning, I observed a young larva of this species on a lilac bush in my garden. I certainly thought that the invention of resting in the hollow of a curved leaf on a rainy day was a very poor one, for, since the bent leaf performed the office of a gutter, the water must flow through this channel, and the larva be inundated and inevitably drowned, if the rain lasted but a few hours. I soon found that there were more brains in the small head than I had supposed. The larva began to move; it spun some silk from one edge of the leaf to the other, and, by adding many fibres to make it strong, each new fibre shorter than the preceding, the leaf was soon made to curve more and more. I then began to understand what this laborious work was for, and I thought that sometimes small people might give lessons to larger ones. After about an hour, the larva ceased to work, a real

bridge was built over the torrent, and upon it, lay motionless, and out of danger, the little larva."

The larvæ of *Epinephele ianira*, and other Satyrids, spin together grass leaves for a puparium. *Polyommatus icarus*, *Lampides boetica*, and other Lycænids, will similarly spin together leaves and flowers of their foodplants. Chapman says that the larva of *L. boetica* will fasten together flowers into a cocoon for pupation, or pupate openly on a pad spun on a flat surface, and asks—Is the puparium the result of spinning a carpet amongst loose material? or, does the carpet result from making the puparium on a flat surface? Poulton considers (*Trans. Ent. Soc. Lond.*, 1904, pp. cxii-cxiii) that the silken material spun by butterfly larvæ for suspension, either by the anal segment alone, or by a girth in addition, is, in all probablity, the persistent trace of a vanished cocoon, and he surmises that the decline of the cocoon, a form of passive defence, built to endure for comparatively long periods, including the time of special stress, was favoured by a short pupal period falling wholly within the time of least stress, and suggests that, when the cryptic colouring of the bare pupal surface is as effective for concealment as that of the cocoon, it presents certain advantages over the latter, etc. The change from a hidden to a cryptically protected pupa, would gradually lessen the need of a specially prepared cocoon, and the transition, he says, is easy, from a loose and open cocoon with apertures through which the cryptic colours of the enclosed pupa could play their parts in defence, through stages in which the latter element becomes more and more important as the cocoon progressively diminishes, to the climax when the almost invisible remnants of the silken covering are retained as supporting structures merely.

The old authors, Swammerdam and Réaumur, gave very lucid accounts of the silk-spinning done by certain larvæ producing suspended pupæ—*Vanessa io*, etc., and those producing pupæ attached both by the cremaster and by a silken girth—*Pieris brassicae*, etc., and the silk-spinning operations performed by such must have been observed by every field lepidopterist, but the details given by Chapman (*Trans. Ent. Soc. Lond.*, 1905, pp. 203 *et seq.*) are exceedingly interesting. He notes that the first spinning done by the fullfed larva of *Thais polyxena* var. *cassandra*, is to form what must be called a cocoon, though it consists merely of three or four, or at most a dozen, rather strong silken cables, sometimes simple, sometimes branching, tying together the objects surrounding the position chosen for suspension. Having prepared a carpet of silk of rather more than its own length, either on a flat surface, or, by preference, on a round one, such as a stem, it makes the anal pad, a somewhat flocculent little mass, and it may be noted here that, in *Thais*, as well as in *Papilio machaon* and *Pieris rapae*, when this is completed, the larva takes its station with the anal claspers just in front of it, the little mound of silk forming the pad being unused, and lying immediately behind the anal claspers and beneath the tip of the anal plate, suggesting that the pupa shall have a freer access to it, than if the anal prolegs held it. In suspended pupæ this pad is held by the anal claspers, whilst the larva awaits pupation. The girth arises well forwards from the carpet of silk in *Thais*, and, as in *Papilio* and *Pieris*, is spun in a position that may be described as being in front of the larva, the head being

thrown back, so that the legs are used as hands to hold it up; not, however, the claws, but the thick bases of the legs are used, the silk not being on the legs proper, but rather in the incision in front of them. This is the position when the spinneret is at the middle of the girth, but, as the head goes from one side to another, the relation of the parts is much changed, though quite gradually and automatically. . . . . The girth when completed consists of a number of quite separate threads, showing that each thread is not spun along, and glued to, those that preceded it, and that, therefore, the extremity of the spinneret does not actually reach and touch the previously spun threads which lie deeper in the incision between the segments. . . . The larva moves very leisurely, and with some to-and-fro movement, so that one traverse of the loop takes about three minutes, and the movements of fastening the end of each thread to the twig about one minute, but, between each complete traverse, usually at least one partial journey is taken, *i.e.*, from the twig for about one-third of its length and then back again, and along this piece, especially towards the end of the process, a good deal of local spinning is done, which covers this thicker portion of the loop with an outside building. When the loop is finished, the central third consists of a number of threads more or less separate, or, at least, apparently separate, straight, parallel, and uncomplicated. The end portions are thicker and bound together as one strong strand. . . . In two specimens watched, the whole process took about $1\frac{1}{2}$ hours in a room at about 64°F. . . . . After finishing, instead of sliding slowly round from the side and bending the head down slowly as it went, to the position it takes when at the central point, it gave it this position at once, so that the head went under the loop somewhat to one side, and, as it then gradually assumed the median position, the thread lay across the middle of the front of the head. At the same time, however, as it assumed the median position, it bent back the head and curved the thoracic segments backwards, so as to bring close together the back of the head and the dorsal thoracic humps; then the thread became slack over the head and slipped back into its place over the 1st abdominal segment. [The peculiar position in which the girth holds the pupa in *Thais* is assumed about 24 hours after the pupa is formed.]

In *Papilio machaon* the loop consists of a number of quite detached threads, which remain quite distinct and separate to much nearer their attachment. The details of spinning the girth are somewhat different (see *op. cit.*, pp. 213-214), and, when finished, the head is put under the loop, and, after sundry movements, the loop slips backwards between the 2nd and 3rd abdominal segments. Chapman further notes (*op. cit.*, p. 216) that the larva of *Pieris rapae* makes its girth in a way that is essentially the same as in *Papilio machaon*, but yet with an amount of variation that renders it actually very different. Essentially the girth is made in front of the larva and between the head and first pair of legs, not between the first and second pair of legs as in *Papilio*, but the raising of the front segments of the larva, which, in *Papilio*, may be likened to the "Sphinx" attitude, is in *P. rapae* carried to an extreme, so that, when the larva is adding to the middle point of the girth, the head is bent back so that the back of the head touches the dorsum, at about the incision between the 2nd and 3rd abdominal segments, the ventral face of head and

prothorax being directed exactly dorsal, and the legs of the meso- and metathorax forwards. As the head is carried to either side, these forward segments so rotate that the venter becomes ventral over all segments, but the forward segments instead of being bent dorsally, are bent laterally, and the head is against the side of the 2nd and 3rd abdominal segments. In all these positions, the loop seems to be fairly tense. When the head is bent to one side, the girth passes over the middle of the 2nd abdominal segment and the middle of the prothorax, the portion of the larva between these two positions being in front of the loop, the rest behind it. In the median position there is, perhaps, a large proportion of the prothorax in front of the loop; indeed, the head only might be regarded as behind the loop. . . . . The completion of the process, when the spinning is done, is really very different from that in *Papilio machaon*. In the latter, the front of the head is put forward under the loop, and it is slipped back into its place by a movement very similar to that by which a thread is added to the girth; in *Pieris rapae*, at the end of fixing the last thread at the side, the head is merely drawn forward from under the loop. Reference might with advantage be here made to Riley's account of the spinning of the girth by the larva of *Euphoeades troilus*, published by Scudder (*Butts. New England*, pp. 1323-4).

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## CHAPTER XIII.

### THE COLORATION OF BUTTERFLY LARVÆ.

Many eminent naturalists, including Lubbock and Weismann, have pointed out that the larvæ of lepidoptera are generally green in their earliest stage. So far as the larvæ of butterflies are concerned, this is only very partially true, and it is well-known that the larvæ of the Papilionids, Vanessids, Argynnids, and other groups are rarely so. On the other hand, the young larvæ of the Urbicolines, Lycænines, Pierines, Satyrines, etc., are very generally so, especially in the case of those species that live on low herbs. Scudder points out that, among the American species, the young larva of *Oeneis macouni* is even brilliantly striped, those of nearly all Papilionids are almost black with a white saddle (as in the Palæarctic species), whilst many others, *e.g.*, *Eurymus* and *Basilarchia*, though having a green tinge, are, nevertheless, so obscured by other colours, as to have a dusky effect, which leaves the colour at most only greenish. We have only, in our own limited fauna, to point to the larvæ of *Papilio machaon*, *Aporia crataegi*, *Pieris brassicae*, *Aglais urticae*, *Vanessa io*, *Melitaea cinxia*, etc., to show how little the suggestion is universally true, whilst admitting, on the other hand, that the larvæ of many butterflies are, when newly hatched, nearly of the colour of the green leaves on which they feed, the various changes in tint which we find in adult larvæ being assumed during growth.

We have already pointed out (*anteà*, pp. 18 *et seq.*) that the larvæ of most butterflies are, when hatched, of a generalised form with exceedingly simple tubercular structure, and that, at the first or second moult, great changes often take place. Scudder points out as being

noteworthy that it is just then that the size of the caterpillar becomes materially enlarged. He says: "At the end of its second stage, the little caterpillar is no more than two or three times as long as at birth, while the rate of growth, subsequent to that, is so great that, in its mature condition, it is ordinarily twenty or more times as long as at birth, and its bulk increases in a far greater ratio. The change of colour and markings has, therefore, direct relations with its visibility, and it is, in this later period, even more than in the earlier, that we see how completely colours which are protective have established themselves. It is now that these oblique streaks upon the sides of the body are apt to show themselves, which, as Lubbock has pointed out, diverge from the general line of the body at much the same angle as the veins of a leaf part from the midrib. Often the colour of these streaks is graduated into the ground-colour in a manner which closely resembles the shadows of a raised vein upon a leaf, and it is only when we examine such objects in free nature that we see how perfect the deception becomes."

The coloration of butterfly larvæ opens up a wide field for study, and the exposed life the larvæ often lead, renders them subject to the attacks of various enemies. The colour of the larva is often an important factor in its preservation, and this operates in two very different ways. In one group of larvæ the colours are such as to respond either in general appearance or in detailed arrangement (or both) with the place chosen by the larva for the purpose of rest; in the other group of larvæ the colours are conspicuous and suggest danger to a foe. The first class of larvæ are sometimes said to have a "cryptic," the latter a "warning," coloration. One of the most striking instances of allied larvæ presenting the two different kinds of coloration is exhibited by the larva of *Papilio machaon*, which, feeding on fennel, and probably offensive to the taste, presents bright "warning colours" of green ringed with black, whilst that of *Iphiclides podalirius*, feeding on rosaceous plants, and assumedly palatable, is of a green colour, delicately marked laterally with pale, and, assuming all the appearance of a leaf of its foodplant, forms one of the best examples known to us of "cryptic" coloration in a comparatively large butterfly larva. But this cryptic coloration is again twofold in its form; there is the coloration, as in that of *Iphiclides podalirius*, in which the larva bears by colour and position an exact and detailed resemblance (in this case a sloe or plum leaf) to some particular object, and there is another in which the general appearance of the larva, combined with the details of its surroundings, presents a general harmony with the environment that not only prevents the larva from being conspicuous, as it would if removed from its setting, but also makes it agree with such remarkable fidelity with the various items that go to make up its surroundings, that it is practically undiscoverable. The case of *Charaxes jasius* (*anteà*, pp. 55-56) will recur at once to the mind, and should here be referred to.

Scudder observes (*op. cit.*, p. 859) that "the colours of caterpillars are by no means so various, nor the patterns so complicated, as is the case with the winged butterflies themselves, but it is nevertheless true that, as a general rule, the different species may be separated from one another with considerable certainty by their marking and colours alone. With caterpillars, the variety of the dermal appendages goes far

towards making up the general appearance of the creature, and, by their aid, combined with their colours and patterns, the separation of species may probably in all cases be tolerably sure. . . . . The vast majority of butterfly caterpillars are green, though but exceedingly few of them, if indeed any, are uniformly green throughout. Most of them are longitudinally striped, either with lighter and darker shades of green, or with yellow or various shades of brown. Many of them have the additional adornment of points of brighter or darker colours, which are almost invariably confined to the little papillæ with which the body is almost always studded. Such are the vast majority of the Satyrids, the Pierids, the Hesperiids, and the Libytheids. These longitudinal stripes are by far more common than elsewhere in the middle of the back, where they mark the course of the dorsal vessel, on the lower portion of the sides, where they mark the alignment of the spiracles, and midway, or about midway, between these two; when most variegated, the stripes are multiplied, especially upon the upper half of the body, and often show a greater degree of intensity at the extreme anterior, or extreme posterior, end of each segment. Other green caterpillars are marked with oblique stripes, which generally part from the darker mediodorsal line at about such an angle, as Lubbock remarks, as the ribs of a leaf part from the main stem. These oblique stripes almost invariably run down the sides from in front backward, generally cross two or three segments, and may or may not join a stigmatal line below, or the dorsal line above."

In a broad way these remarks of Scudder are true, and, even in the Palæarctic Satyrids, where the larvæ of allied species sometimes run very close indeed, the number, direction, and general character of the lines will usually distinguish the species. The character of the markings of the Satyrid, Pierid, Hesperiid, and Libytheid larvæ, although consisting of longitudinal lines of a different shade from that of the ground-colour, is essentially different in each of these groups, and the position and arrangement of the lines, apart from the mediodorsal line, are generally quite *sui generis* within the limits of each separate family. This is particularly the case in the Pierid and Libytheid larvæ. Those of the Satyrids and Urbicolids (Hesperiids), being largely grass-feeders, present much more marked general similarities than do the others to these, or to each other. The grass-feeding larvæ, too, also present a markedly large percentage of dimorphic forms—green and pale brown—whilst many are only brown (green being an unknown or exceedingly rare colour aberration in the larvæ of these species). Almost all these groups present excellent forms of cryptic coloration. Lubbock long since pointed out that longitudinal stripes are very common markings, and are most common, and, indeed, almost universal, upon such larvæ as feed upon grasses and other elongated forms of vegetation, while they are comparatively rare upon such as feed upon broad-leaved plants, a general statement, particularly verified in the larvæ of the Satyrids and Urbicolids (*sens. rest.*), and, to a less extent, in those of certain Pierids, *e.g.*, *Euchloë*, *Anthocharis*, etc., where the resemblance is to the long seedpods of the foodplants, rather than to the leaves, at least in the later stages. Of this, Scudder notes that "the green colour of all the North American Rhodocerids and Pierids, and notably of *Eurema lisa*, which feed upon broad-leaved plants and lie exposed upon the surface beside the midrib

or prominent vein, conceals them almost completely from view, even when the eye is fastened upon them; the long and slender form of *Anthocharis*, with its striking longitudinal stripes, would seem to render it a conspicuous object, but when seen upon the lank vegetation upon which it lives, beside the long-drawn seedpods, it would hardly be noticed. Even the colour of the huge caterpillar of *Jasoniades glaucus* is such an exact imitation of that of the leaf upon which it rests, and whose sides it has so turned up that no profile view may be had of it, that it does not readily catch the eye." Of the protective resemblance exhibited by a particular species of this class of larva Chapman writes (*in litt.*): "I do not know what is really *the* foodplant of *Leptidia sinapis*, but I reared a few this year on *Lathyrus pratensis*, and, if the close assimilation of the larva to all aspects of its foodplant is any criterion, then *Lathyrus pratensis* is *the* foodplant of *L. sinapis*. More probably, however, *the* foodplant is some plant of similar habit that less affects the open field. Such plants as *Orobus tuberosus* and *Vicia cracca* do not appear to be quite apposite. The larva, for a Pierid, is rather long and slender, and, stretched out along a stem, or a petiole of a leaf, is extremely difficult to see, the coloration being identical, the white stripe on the larva representing light and shade effects on the plants. In changing the food of my few larvæ, I had, on several occasions, to go over the plants two and even three times before I could find all the larvæ. In the youngest larvæ, the hairs agree very closely in general aspect with those of the plant, greatly increasing the difficulty of observing it. The young larva of *Iphiclides podalirius*, too, black, with yellow markings and very remarkable hairs on the warts, must resemble something or other, but what is not self-evident. In its second instar, however, it assumes practically the adult colouring and markings, and, sitting quietly all day at rest on its pad of silk, is hardly visible even on the middle of a leaf of blackthorn."

We were much struck this year with the appearance of a full-grown larva of *I. podalirius* resting on a twig of blackthorn, which so much resembled a leaf, that, after it was discovered and the branch picked, we actually thought on one occasion, whilst carrying it, that we had dropped it, and only a closer examination revealed it as still there. Of similar cases, Sich observes (*in litt.*): "The larva of *Euchloë cardamines* among the pods of *Sisymbrium alliaria*, both in shape and coloration, is very particularly attuned to its surroundings, so also is that of *Apatura iris* on a sallow leaf in the open, and that of *Cupido minima* among the calyces of *Anthyllis vulneraria*, and any of these might readily be passed over even by an entomologist. Chapman further notes (*in litt.*): "I observed a young larva of *Lampides boetica* resort to a device for hiding itself that must be not unusual with it. In about its third instar (3mm. long or thereabouts) it was in the open. At this stage it is very often buried in the interior of a blossom, but this specimen was on a branch of *Ulex nanus*, on which I had watched a ♀ *L. boetica* lay an egg, and, quite accidentally, I observed this larva after gathering the branch. The branch had no flowers, but only buds, generally still of very small size. This larva had probably fed on these buds, none of which were large enough to contain it. It had placed itself along the upperside of a spine, with its head close into the axillary hollow, and so, in position, form, size, and colouring, it exactly resembled one of the small flower-buds, of which a good

Plate XVII.

*Photo. Hugh Main.*

1. Strymon w-album on elm leaf. 2. Apatura iris hybernating on sallow leaf × 2. 3. Melitæa didyma on plantain.

Protective resemblance in butterfly larvæ.

*Natural History of British Butterflies*, Dec., 1906.

many occurred on the branch. I handed this twig to an entomological companion, who was quite unable to discover the larva, although I approximately indicated its position, and though, of course, recognising it at once when pointed out. My discovering it was due to examining it as a supposed bud, to see if an egg of *L. boetica* had been laid on or beside it. The young larvæ of many (all ?) Lycænids have the setæ of i and ii long and curved, longer than the thickness of the larva usually, and they stand up along its dorsum as a crest. This is a very conspicuous arrangement, yet, in many instances, when the young larva is on the surface or edge of a leaf, or at the margin of a calyx, boring through its tissue into a flower, this fringe of hairs obscures the larva, even when examined through a lens, by its resemblance in size, form, and colouring, and in some degree in disposition, with the hairs of the plant. The larger larvæ of *L. boetica* were often easily seen, but often also were very invisible. This depended a good deal on whether they were amongst flowers or buds, or were moving or resting. From the second instar onwards, they closely resembled in colour and texture the calyces of the *Adenocarpus intermedius*, which was a very favourite foodplant, and not infrequently disposed themselves so as to look like a flower-bud. These buds, at first greenish, are varied with red-brown, like the seed-vessels, and, like them, are clothed with sticky glands. The larva varies much in colour as it gets older, generally retaining an olive tint, due to a brown overlying green, and, in colour and form, are inconspicuous amongst calyces and young seed-vessels. They also, not infrequently, spin themselves slight cocoons, not always, so far as I could satisfy myself, to pupate in. Another variety of full-grown larva was dull yellow, obviously well-suited to assimilate with yellow papilionaceous flowers. The great variety in tint of the larvæ is possibly related to the species having numerous foodplants, and also, perhaps, to the exigencies of texture requiring the larva sometimes to hide amongst buds, sometimes amongst flowers, and again, but this is clearly contrary to its preferences, amongst pods or where there are no buds or flowers. *Lampides telicanus* has almost identical habits and much variation as a larva, brighter in colour and often variegated, *L. boetica* being more unicolorous. It differed also in never presenting to us a yellow larva, nor in making a cocoon except for pupation." Bearing on this same subject, Sich writes (*in litt.*): "It is well-known that the calyces of *Thymus serpyllum* are usually of a purple tint and hairy, and the young larva of *Lycaena arion* is also of this colour, and also very hairy. When the little larva is half buried in a calyx, or, when on the calyx, eating into the corolla, it is difficult to discover, even by aid of a lens." He also adds further, "the pale green fullfed larva of *Chrysophanus dispar* var. *rutilus* adheres closely to the leaf of the dock, *Rumex hydrolapatheum*, and, from its peculiar shape, casting little shadow, is remarkably well hidden. It is rather yellower than the dock leaf, and might easily be passed over as a spot of sunlight. Its dermal covering, moreover, harmonises well with the leaf. Its skin is covered with little white cup-hairs, which, to the unaided eye, look like white dots, resembling somewhat the white points on the dock leaf, especially numerous about the veins on the underside." The same observer's remarks on the protection afforded to the larva of *Nisoniades tages*, by the similarity of its colour and shape to the leaves of *Lotus corniculatus*, are detailed at length (*posteà*, p. 272) and need not be here repeated. Turner thinks

that the immovable position adopted by the larva of *Ruralis betulae*, as well as its unfailing position of rest along the midrib of a leaf, combine to form a most efficient means of protection, the larva being, indeed, most difficult to detect.

We do not, however, believe that the larvæ of the Satyrids, with their longitudinal markings, especially when adult (or almost so), are to be considered as special (so much as general) cryptic forms, *i.e.*, we think that the larvæ owe more to their general, than to their detailed, resemblance to their surroundings, and that the longitudinal lines are more effective as producing effects of light and shade, than an exact similarity to the parallel venation of the grasses on which they rest, and this is the more readily believed because of the dimorphic or dichromatic conditions arising in many of the adult larvæ as they approach maturity, so many presenting two distinct shades—green and brown—of ground colour marked with darker lines, the brown forms being probably as strongly protective among the dying culms, as the green on the living ones as summer advances. Poulton also argues that this larval dichromatism is advantageous to the species, because, when once a larva of one of the colour forms has been discovered by an enemy, others of the same colour would be more easily found by this enemy, whilst the other would be overlooked, so that, whilst one form might suffer, the species would be saved through the escape of the other. Weismann believes that this change has been brought about by natural selection, but Semper urges that selection "could not possibly effect any alteration in the pigment, but could only operate after such a change had occurred," whilst Scudder rightly points out that such changes may occur in nature directly, and instances the fact that, in a number of caterpillars, and, particularly in those of the Papilionids, an entire change of colour takes place just previous to pupation. Of this particular change in colour he says (*op. cit.*, p. 1146): "The period of pupation is probably the most hazardous for an insect, so far as its active external foes are concerned, it being absolutely helpless at this period and in a very sensitive state. The time required for the change is much greater in any one species than for ordinary ecdysis in the same species, and, whatever the purpose of the change in coloration may be, it will hardly fail to be noticed that, in general, all vivid colours are subdued and entirely neutral tints assumed."

Dealing with another, and entirely different, group of butterfly larvæ, Scudder observes (*op. cit.*, p. 860) that "some shade of dark greenish-brown is a very common ground tint of the caterpillars of butterflies, and these are often longitudinally striped, as is the case with the larger part of the Argynnids, Vanessids, etc. Here, as before, the stripes are more common in the neighbourhood of the stigmatal line and the dorsal vessel, but they are more commonly broken by the varying intensity of the colours, and are frequently accompanied by an edging, which is but the ground tint intensified at the border. A considerably greater variety is also seen here, from the more or less definite arrangement of the differently coloured papillæ in transverse lines across the body, so that, by the combination of these two forms of transverse and longitudinal markings, almost any conceivable pattern may arise, and one which may be highly complicated. Thus a bright coloured spot marks each segment of the abdomen above, in *Euranessa antiopa*, giving it a very different aspect from the pepper and salt

coloration of its near ally, *Hamadryas io* of Europe." We are inclined to consider the coloration of the larvæ of this group to belong, on the whole, to a warning type, the spines helping in the purpose of protection, whilst the gregarious habit adopted by many species no doubt intensifies the gain obtained by these in other directions. Yet the markings of the true Argynnid larvæ are, in no wise, as here assumed by Scudder, to be so certainly grouped with those of the Vanessids, for they are assuredly, in some species at least, of an entirely different character, those of the Melitæids coming much nearer to those of the Vanessids in general coloration, markings, etc. Scudder himself sees this and observes (*op. cit.*, p. 1144) that "the larvæ of the Argynnids, which conceal themselves upon the ground, are almost black, and can hardly be distinguished except when in motion"; but one doubts even here whether cryptic coloration in these could not be brought nearer to our senses if we were more conversant with the wild habits of some of these larvæ, especially those that live solitarily, *e.g.*, Chapman writes (*Ent.*, xxxviii., p. 73) on the cryptic form and colouring of *Melitaea* larvæ, observing that "the larvæ of *Melitaea cinxia* and *M. athalia*, when fullgrown, are usually very conspicuous, still it often strikes one that, obvious as they are when one looks for them—*i.e.*, if they are not hidden away—one may easily pass by without seeing them, even though looking where they are, if not thinking of them. These larvæ considerably resemble the heads of *Plantago*, but this is still more the case with that of *M. didyma*, whose yellow and brown markings make it very like a plantain-head, with yellow stamens and brown scales."

We have already noted that certain brightly coloured butterfly larvæ are supposed to have a "warning" coloration, and to obtain a measure of protection from their offensive properties, and have instanced *Papilio machaon* as one of such (*anteà*, p. 62), but such larvæ also often gain by their general resemblance to their surroundings as a whole, and Scudder observes that the conclusion that many of these bright larvæ gain their protection largely from their unpalatable nature is not altogether acceptable, and he says that "it is a little perplexing when one examines the large, naked, and exposed larvæ of the American Papilionids, *e.g.*, *Laertias philenor*, its black body with projecting orange points set off vividly against the dark green of the *Aristolochia*, or the gay bodies of *Iphiclides ajax* and *Papilio polyxenes*, with their transverse stripes of brilliant orange, green and black, to assert that these are warning colours given to show the inedibility of the larva, possibly indicated also by the nauseous odour of the osmateria, when, in *Jasoniades glaucus* and *Euphoeades troilus*, with the same osmateria, we have protective colours of no mean importance. They may, however, be explained as protective, at least in part, for the larvæ of *Laertias* conceal themselves beneath the broad leaves of *Aristolochia*, so as not readily to be found but for the marks of their presence in their droppings, and, although one finds it difficult to look upon the colours of *Papilio polyxenes* (the more striking of the other two mentioned) as in any sense protective, it is nevertheless true, as pointed out by Poulton, with regard to the similarly coloured larva of *P. machaon*, that the protection afforded by the colouring of these insects is 'very real when the larva is on the plant,' and can hardly be appreciated at all when the two are apart." To us, the point made by Poulton appeals strongly. Conspicuous as the larvæ of *Papilio*

*machaon* or *P. alexanor* may be when on a bare stem or other conspicuous point of vantage, in direct line with the human eye, yet, when on the foodplant and among the foliage, a casual glance is rarely sufficient to discover them, and if one wants them, one must prosecute a close and prolonged search. Chapman has already noted (*anteà*, p. 64) that he fails to see the particular meed of protection gained by the peculiar aspect of the young larva of *Iphiclides podalirius* and, unless it be that which it apparently bears to a bird's dropping, we cannot tell what it is meant to represent; Chapman thinks that the larva is much too small in this stage for this to be the real explanation in this case; yet one supposes, since the same general appearance is common to most young Papilionid larvæ, that the value to the young larva is real, a view that is strengthened by the fact that, in some species, this same appearance, or a slightly modified form thereof, has been found effective almost throughout life, no change of importance taking place in its general appearance until the larvæ are in their last or penultimate skin. This, probably, is the answer to Chapman's objection, *viz.*, that all the larvæ in the group did, at one time, keep this appearance throughout their larval existence, as is the case now in *Heraclides*, and that this, what may be termed generic, appearance has been, in some species, pushed back to the advantage of special protective development, until, at last, the form is only found in the first instar. In *I. podalirius*, therefore, it now has, possibly, only a shadow of its former value, and Bacot says (*in litt.*) that, "at Martigny, in August, 1906, the young larvæ in their first instar were especially noticeable to human eyes, when search was made on a species of wild cherry, but less so on blackthorn. He adds that he saw neither holes nor spots on the leaves of the foodplant that could assist a cryptic scheme, and that, in this instar, the larva was certainly as easy or more easy to find than that of *P. machaon* in the same skin." The appearance that makes certain butterfly larvæ bear considerable resemblance to a bird's dropping is not confined to Papilionid larvæ, and Scudder observes (*op. cit.*, p. 1146) that "some butterfly larvæ possess features of a very surprising character, doubtless for the sake of protection one of the commonest of which is the striking contrast between creamy-white and black, or some other dark tint, which makes the creature resemble the vermiform dropping of a bird. This is true of all the American species of *Basilarchia*, of *Polygonia faunus*, and, especially in their middle stages, of several Papilionid larvæ, such as those of *Euphoeades troilus* and *Heraclides cresphontes*." It is equally true of the larva of *Polygonia c-album* and the young larva of *Papilio machaon* in Britain, and the peculiar position usually taken up on the stem or petiole of the foodplant by the larva of the latter, and the peculiar coiled position of rest in the middle of a leaf adopted by the former, give additional point to the suggested resemblance.

Little is really known about the larvæ of the huge mass of tropical Papilionid species; but the studies of Edwards and Scudder have given us some important facts about the North American species to add to those already known concerning the European species. Scudder gives a brief review of the changes that the larvæ of the former undergo in his *Butts. New England*, pp. 1234-1241, and thus summarises his facts (p. 1238): "There is a somewhat general uniformity of type in the earliest stage of larval life among the Papilionines, whilst there is an

extraordinary diversity in the same caterpillars when fullgrown. Some alter very much less than others, some assume the mature aspect by slow degrees, others suddenly, and at very different periods of larval life, *e.g.*, the mature form may be said to be assumed in the second stage by *Laertias* (*philenor*) and *Iphiclides* (*ajax*), at the fourth by *Heraclides* (*cresphontes*) and *Papilio* (*polyxenes*), in the course of the fourth by *Jasoniades* (*glaucus*), and not until the final stage by *Euphoeades* (*troilus*). The assumption of maturity is shown by several distinct features, which, in general, are correlated—the form of the body, the broad features of the colouring of the body, and the loss of the juvenile armature. In only one instance, *viz.*, the larvæ of the species belonging to *Papilio*, are the tubercles retained (and here only for a single stage) after the adult form and markings have appeared, and, excepting *Laertias*, where the markings are almost null through life, *Heraclides* is the only example where the ornamentation of the body of the adult in any way resembles that of the newly-born caterpillar." As a general conclusion, Scudder assumes that "the ancestral Papilionid larva was covered with rows of fleshy, mammiform tubercles, beset with bristles, and that these were retained through life; but that, in the gradual development of the group, they were lost, first at the final stage, as we now find it in *Papilio*, afterwards at successively earlier and earlier stages; the loss consisting, first in the removal of the bristles, afterwards in the lowering of the tubercles until only smooth and shining lenticles remained, as now exhibited in the full-grown caterpillar of *Heraclides*; these again, in several genera, were replaced by coloured spots, some of which, *e.g.*, *Euphoeades* and *Jasoniades*, assumed special forms. It may further be presumed that the early larva was dark in colour, probably of an uniform dark colour, with a tendency towards a deepening of the tint of the region about the 3rd thoracic segment (which only assumes a special importance in these larvæ), and also about the 7th abdominal segment, by the tendency of both markings and dermal appendages to assume a polar arrangement in elongated forms. By this means, and through the intensification of these contrasts, arose the lightening of the middle parts of the body to form a saddle-shaped whitish patch—a marking surely of great antiquity in swallow-tail larvæ, since it is now found at birth in four of the six genera found in North America, and a fifth shows a tendency towards it. This style of marking has been retained throughout life in *Heraclides* only, of all the members of the Nearctic fauna; and, as it is in just this genus alone that the lenticle traces of the tubercles persist to maturity, we have certainly in *Heraclides* the perpetuation of a very antiquated type. That, in *Papilio*, we also have a very persistent type, may be judged from the great stability of the upper tubercles, which are even now not lost until after the assumption of the changed livery of maturity, a livery which owes a part of its variety and enlivenment to exchange of some of these tubercles for bright-coloured spots; these break up the transverse black stripes in a variable degree, and the stripes themselves appear to be but little more than retention of parts of the original colour (freed at the particular spots they occupy by the central position of the black tubercles), when the green livery of adult life is assumed, for it seems to be a green resembling the green of the leaves upon which the larva lives, that is, the ultimate aim of most Papilionid coloration. In

caterpillars of their size, other colours would be too conspicuous for their advantage, and variation in this direction would be natural. Moreover, it is the colour reached, or partly reached, in several different ways, as the development of the other types show; thus, in the other striped caterpillar, *Iphiclides*, the stripes grow obsolescent towards maturity, and leave the larva more completely green. Hence, we may trace several lines, to a certain extent parallel, along which the modification of Papilionid larvæ has developed, parallel, at least, in that the loss of the juvenile tubercles has been universal, though not always complete, their loss being generally made good by lenticles, and these by spots, and sometimes, by acceleration, a phyletic stage is set further and further back, and finally, perhaps, crowded out. One of these lines, very distinct from the others, is found in *Laertias*, which has developed in so high a degree that its juvenile bristles, themselves exceptionally simple, are completely lost with the earliest stage; so, too, are most of the tubercles; but here a very curious change occurs, those which are lost are replaced in new positions by others entirely different, which take on a more elongated form, and become more properly fleshy filaments, whilst those which remain assume also the new development. The dark and almost uniform colour of the larva throughout life, is to be explained probably by acceleration; it is the mature colour thrust back into the juvenile stage, to the obliteration of any trace of the saddle which once may have prevailed there, and is in keeping with the present, almost complete, assumption of the mature characters at the second larval stage. In support of this position, may be pointed out the fact that traces of the saddle still exist in the mature forms of other filamentous Papilionid caterpillars allied to *Laertias*—*Ornithoptera*, *Menelaides*, etc.—indicating a still larger development of the same in the earlier stages of the types with which, unfortunately, we are not yet acquainted. In *Laertias*, then, the saddle has been crowded back out of existence. Another line of nearly as high development we find in *Iphiclides*, where the extraordinary bristles and tubercles are lost with the very first stage, and maturity marks the second. Here again no saddle appears, the only trace of it left being in the slight deepening of the colour in the new-born larva near the extremities of the body; here I conceive that the phyletic stage marked by the saddle, and formerly developed in later stages from the incipient contrasts of the first, has been pushed back without invading the first until it is entirely skipped. A third line is represented by the remaining genera, in which the saddle is definitely formed and becomes a marked feature of the earliest stages, to be lost only at a comparatively late period of life, in one instance, *Heraclides*, not at all. Its loss, however, is effected in two very different methods, as already pointed out, in *Papilio* and in the other genera, indicating lines along which future strikingly different processes may go on with widely different results—in curious contrast with the somewhat similar results following quite different lines which we see in *Iphiclides* and *Papilio*. In *Euphoeades* and *Jasoniades* we see also the development of special and complicated markings from the simple spots which have replaced the tubercles; traces of the same may be seen in *Heraclides*."

As to the value of the bright colours presented by certain of these Papilionid and other larvæ, Scudder specially notes (*op. cit.*, p. 860)

those that, upon a bright green or olive ground, find all their conspicuous markings in dark stripes encircling, or almost encircling, the body, and which are generally especially conspicuous upon the upper surface, such being notably the case in the genera *Iphiclides*, *Papilio* and *Anosia*, and less so in *Cinclidia* and *Euphydryas;* or, he says, the "lighter and darker colours of the body may segregate in a more massive way, and exceedingly conspicuous broad bands follow the length of the body, as in some of the *Melitaeidi* of Europe; or they may congregate in large dorsal saddle-like patches, as in all our species of *Basilarchia*, and in several of the Papilionines, either in their earlier or later stages, as has already been noted and dealt with at length (*suprà*). Indeed, it is in the latter that we find, perhaps, on the whole, the most striking and extraordinary freaks of colouring to be found among butterfly larvæ, the great variety, even among the few genera inhabiting North America, being only an intimation of what may be found in tropical countries where the family is so much more fully represented. The eye-like spots of the swollen anterior segments, coloured in such an extraordinary and admirable manner, the opalescent and jewelled dots which besprinkle the dorsal surface, the brilliant fleshy appendages which sometimes adorn the sides; the frequent contrasts of such colours as bright orange and velvety-black, not to mention the curious differences in the markings between the earlier and later stages, reveal the possibilities of natural selection in the adornment of caterpillars. These brilliant colours are perhaps only possible by their possession of protective osmateria."

It will be observed above that under the generic name *Iphiclides*, two species with larvæ showing very different modes of protection have been noted, *viz.*, *Iphiclides podalirius* and *I. ajax*. Both these agree in attaining adult coloration with the second instar, but this adult coloration develops on entirely different lines in the two species. In *I. podalirius* its colours are so definitely cryptically protective that one cannot fail to mark them; in *I. ajax* the colours are brighter, the markings are in the form of somewhat brilliant stripes, but Scudder doubts (*anteà* p. 67) them being merely "warning colours to show off the inedibility of the larva," and particularly adds later (*antea* p. 70), that "the stripes of *I. ajax* grow obsolescent towards maturity and leave the larva more completely green." That the difference in the markings of the larvæ of these two closely allied species is more or less definitely "cryptic" and "warning" respectively, appears, however, to be further borne out by the nature of the osmateria scents, for, whilst that of *I. podalirius* is quite pleasant and fruit-like, and certainly not offensive, that of *I. ajax* is described by Edwards (*teste* Scudder, *Butts. New England*, p. 1273) as being "a peculiarly acrid and sickening odour, which must effectually protect them," and, in a letter, Edwards adds that he does "not believe a starving bird would touch one, the stench being so strong as nearly to turn one's stomach."

Bacot thinks that the cryptic coloration of the adult larva of *I. podalirius* is more effective on some foodplants than others. He opines that, on blackthorn, when viewed laterally, the cryptic appearance of the larva is very good; viewed dorsally, the rust-red spots fit in well with the notch in hawthorn, but are out of place for blackthorn; on the plant which it mostly affects at Martigny, a species of wild cherry, with leaves more suggestive of pear, it did not seem to be

so well protected; one could usually detect a larva on a stem at the first or second glance and no amount of searching revealed any more.

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## CHAPTER XIV.

### THE RESTING-HABITS OF BUTTERFLY LARVÆ.

The question of the resting-habits of butterfly larvæ opens up a series of phenomena connected with their vital energies that are most difficult of explanation. The resting-habits cannot all be dealt with under one category, for there is considerable difference between the lethargy following a meal, the longer period of time when preparing for, and undergoing, a moult, and, finally, the very long period which some butterfly larvæ undergo during their hybernation, when all the active functions appear to cease, and when a larva makes scarcely a sign of life, maintaining for weeks, and months maybe, a fixed position from which it never stirs or moves, and this, during the time which we have learned to look upon as the most active of all the early stages, that stage which is utilised not only for eating so that full growth may be attained, but also that material may be stored for the metabolism of the pupal stages and the formation of the imago.

The simplest of these resting-habits is that which takes place after a larva has eaten a meal. Possibly all butterfly larvæ do this, and the position that they take up during this period is so important, that it may be said that it is to meet their requirements for protection at this time that the various schemes of protective resemblance in butterfly larvæ, probably slightly different in each individual case, have been brought about and perfected. Some hide themselves beneath a leaf, *e.g.*, *Ruralis betulae*, where the larva looks like a spot of sunlight from beneath; or they crawl down to the stem of the plant as in the case of *Anthocaris belia*, or *Euchloë cardamines*, where they become, with their lines and markings, a part of the stem, or they choose an exposed position, as in the case of *Charaxes jasius*, when it is protected by its general resemblance to its surroundings. This latter species spins a silken carpet on the upper surface of a leaf on which to rest, going to neighbouring sprays for food, and returning to the silken pad to rest, basking a good deal in the sun during the day, not changing its station often, sometimes probably not at all during the whole of the larval life. Its scheme of general cryptic coloration is excellent (*Ent. Rec.*, ix., p. 193). The value of thus retiring during the period of digestion, and the importance of the position they take up when thus at rest, are self-evident, for it is whilst the larva is moving about that it is in most danger from its many enemies, and, conversely, it is safest when hidden and at rest. The fact that a large percentage of butterfly larvæ feed only at night, and rest hidden during the whole of the day, suggests an even enhanced measure of protection to such larvæ, during these daily resting-periods; thus the larvæ of *Laeosopis roboris* rest during the day time, huddled up close together on the shady side of the stem of an ash, near the ground, and only

leave their retreat at night (Nicholson, *Ent. Rec.*, vii., 186); the larvæ of *Ruralis betulae* live under the leaves of their foodplant by day and feed by night (Russell, *Ent. Rec.*, viii., p. 104); those of *Enodia hyperanthus* hide down among the roots of grass by day coming up only to feed at night (Wolfe, *Ent. Rec.*, viii., p. 5). Still the longest of these rests lasts but a short time, and bears little comparison with either of the longer resting periods yet to be noticed. Before, however, leaving this subject, one may enter into a little more detail.

Scudder observes that many Satyrid and Argynnid larvæ largely confine their activities to the night-time and retire to some place of concealment during the day, the Argynnid larvæ, with their dusky clothing, retiring to the surface of the ground where they are least liable to be seen, the Satyrid larvæ remaining upon the stems of blades of grass or sedge which form their food, and among which they rest concealed. Some larvæ, he says, retire to the underside of a leaf, *e.g.*, *Polygonia faunus*, *Junonia coenia*, and *Laertias philenor*. With regard to the Argynnid larvæ, Buckler observes that the larva of *Argynnis adippe* takes its meals in a most quick and hurried manner, and, if disturbed, runs off remarkably rapidly, whilst the larva of *A. aglaia* also eats with great rapidity, retreating, as soon as its meal is finished, below the leaves, &c. The larva of *Brenthis selene*, too, almost appears to have an aversion to the light, hiding on the underside of leaves, or on stems shaded by leaves, and feeding, as far as possible, whilst thus hidden. Powell further notes that the larvæ of *Brenthis euphrosyne*, *Argynnis elisa*, and *Dryas paphia*, are also naturally night-feeders, resting on the undersides of dead leaves and on dead twigs near the foodplant during the daytime, although sometimes they come out and bask in the sunlight fully exposed. The resting-habits of Satyrid larvæ during this period are very interesting. When young, the larva of *Hipparchia semele* remains rigid on its food, with its head uppermost when feeding, which, at first, it does at intervals both by day and night, and continues to do so until it is about 1 inch long; after this it appears to feed only by night, remaining all day at rest on the grass, with its head downwards, in comparative darkness, among the lower part of the culms. This appears to be a common habit among Satyrid larvæ, for that excellent observer, Powell, notes (*in litt.*) that, among the larvæ of this group, *in sensu latiore*, those of *Melanargia lachesis*, *M. galatea*, and *M. syllius*, hide low down in the grass tufts during the day, when they are getting of fair size, feeding then only by night, but, until the end of the second stadium, they rest on the grass culms and feed by day; and the same observer further reports that the larvæ of *Erebia scipio*, *E. epistygne*, *E. zapateri*, *Satyrus circe*, *S. hermione*, *S. alcyone*, *Hipparchia prieuri*, *H. arethusa*, *H. neomiris*, *H. dryas*, *H. cordula*, and *H. actaea*, are all day-feeders up to the third stage, after which they appear to be purely nocturnal feeders, resting and hiding by day, low down on, or among, the grass culms and roots, whilst the larvæ of *Hipparchia fidia* and *H. statilinus*, feed by day, practically up to the end of the 3rd stage, when their colour changes, and they become night-feeders, resting and hiding by day low down, like the larvæ of their close relatives. Without being quite sure as to the exact point when the larvæ of *Epinephele ianira*, *E. ida*, and *E. pasiphae* cease to be day-feeders and become night-feeders, resting the whole of the day, Powell notes that the larvæ of these species are day-feeders when quite young, and nocturnal feeders later, the larvæ resting low down on the plant, those

of *E. ida* and *E. pasiphae* often leaving the foodplant, and concealing themselves under dead leaves or twigs close to the grass, sometimes quite on the ground. Of other butterfly larvæ that feed by night, and rest hidden during the day, one may notice those of *Thais polyxena* var. *cassandra*, and *Thais rumina* var. *medesicaste*, which, during the day, rest concealed on the underside of leaves of their foodplant or those of other plants growing near their food; the larva of *Thais medesicaste*, in its last stage, often hides under stones around the roots of its foodplant, or amongst the stones of walls out of which the plant sometimes grows. Our own impression, too, is that the larvæ of *Pyrameis cardui* and *P. atalanta* also mostly feed by night, remaining practically still during the day, but, as both the resting and feeding is done within their tents, it is difficult to make certain that this is so. Sich observes that *captive* larvæ of *P. cardui* were several times observed feeding by day within their tents.

We have already noted that certain larvæ choose an exposed position on which to rest between their meals, and have instanced the larva of *Charaxes jasius* (*anteà*, p. 72), and it is interesting further to note that the larva of this species feeds naturally by night, in spite of its exposed position of rest by day. With regard to this, Chapman observes that the larva of *C. jasius*, "between its meals, rests on the upper-surface of a leaf, or of several leaves fastened together by the silken carpet with which it clothes their surface, and which is necessary to give it a firm foothold," etc., Powell adding that the meals are taken by night and are of comparatively short duration; whilst, the larva of *Basilarchia archippus*, Scudder says, "eats the nearest bit of the leaf on which it finds itself, down to, but not including, the midrib, first on one side and then on the other, retiring near the tip of the midrib to digest it; it takes its subsequent meals in the same way, moving with excessive deliberation along its narrow path, and returning always to the same spot. On this perch, it cannot be seen from below, and, from the sides and above, seems almost or wholly a part of the denuded mibrib to which it clings, more particularly when the leaves are set in motion by the wind, as they usually are on the trees on which it feeds, particularly in the case of the aspen." The resting-habit of the larva of *Charaxes jasius* is closely paralleled by that of *Apatura iris*, which covers a leaf of sallow with silk, on which to rest when not feeding; when thus resting, its head points towards the leafstalk. Feeding takes place much oftener by night than day, the larva quitting, for this purpose, the silk-covered leaf, to take a rapid meal, and returning again to the same place to rest (Buckler). The larva of *Iphiclides podalirius* also appears to feed almost entirely by night, and to rest exposed after feeding, often returning to take up the same position on a stem or branch to rest between its meals; this position is usually well up on a branch, where its colour and resemblance to a leaf make it very difficult to see, without pulling down and examining the branch closely.

Most larvæ of Papilionids, however, feed by day, but none the less take up a very definitely exposed position on their foodplant, between meals, *e.g.*, the larvæ of *Papilio machaon*, *P. alexanor*, and *P. hospiton*, and Scudder notes that the caterpillars of some of the Nearctic Papilionids have a favourite place of repose to which they retire after every meal, and which they carpet with silk, the larvæ resting upon the middle of

the uppersurface of the leaf, upon the floor of which they have stretched a silken carpet from side to side, each strand shorter than the last, so as to make the edges curl towards each other, and sometimes to meet, and thus form an open nest, *e.g.*, the mere partial curling of a leaf to conceal its sides is sufficient for the larva of *Jasoniades glaucus* during its resting-periods, whilst that of *Euphoeades troilus* turns the leaf completely over, so that the opposite edges touch, the larva resting entirely concealed.

Many other larvæ that feed by day rest exposed during the periods in which they take their meals. Of these, we have already noted (*anteà*, p. 72) *Anthocaris belia* and *Euchloë cardamines*, whilst the larvæ of their allies, *Anthocaris simplonia* and *Euchloë euphenoides*, have precisely similar habits; so also have the larvæ of *Pontia daplidice*, *Pieris rapae* and *P. brassicae*, although the larva of *P. rapae* is often found partly concealed on cabbage, yet usually quite exposed on *Tropaeolum* or mignonette. The larvæ of *P. brassicae* rest in groups, fully exposed, usually side by side, on the leaves or stems of their foodplants. *P. brassicae* appears to take no steps to hide itself at all, and is, contrary to the other larvæ noted, conspicuous, its colour possibly being "warning" in the fullest sense. The somewhat allied larvæ of *Gonepteryx rhamni* and *Colias edusa*, on the other hand, feed by day, rest fully exposed, yet are most difficult to see, on account of their great similarity in colour, tint, etc., to their resting-places. In searching for the former on *Rhamnus frangula*, it is necessary that one should place oneself so that the sunlight falls across the leaves examined, when the shadowed side of a larva comes into view and discovers it; otherwise it so exactly resembles the midrib along the centre of the leaf (where it rests), that it readily escapes notice. It may be here remarked that some Satyrid larvæ trust, like most of those of the Pierids, to their similarity to their foodplant to escape notice, feeding like them by day and remaining throughout the periods between one meal and another on the foodplant, fully exposed in the sunlight; such are the larvæ of *Pararge megaera*, *Coenonympha dorus*, etc.

Whether the larvæ of the Ruralids (Theclids) are, on the whole, day-feeders that hide during the time that elapses from one meal to another on the underside of leaves, or largely night-feeders, is not clearly known. We have already recorded (*anteà*, p. 72) the former to be the case with the larva of *Ruralis betulae*, and we believe it to be so with the larvæ of *Strymon* (*Thecla*) *pruni* and *S. w-album*, whilst Powell notes (*in litt.*): "I believe the larvæ of *Thecla aesculi* and *T. acaciae* to be day-feeders, but cannot say that they are not also night-feeders; they rest under the leaves which they resemble closely in colour. The larvæ of *Thestor ballus* feed by day among the leaf-buds and flowers of *Anthyllis tetraphylla*, *Lotus ornithopodioides* and *Bonjeania hirsuta*, whilst those of *Lampides boeticus* hide and feed in flowers and flower-buds of *Medicago sativa* and other leguminous plants, and those of *Lampides telicanus* also rest practically in their feeding-places in the flowers of *Lythrum salicaria*," etc.

We have already mentioned (*suprà*) the case of the larvæ of a Papilionid, *Euphoeades troilus*, that enclose themselves in the folded leaf of *Benzoni odoriferum*, during the periods of rest between a meal and the following one. We have also remarked (*anteà*, p. 54) the habit of the larvæ of *Pyrameis atalanta* and *P. cardui* to remain in

their tents during both their feeding- and resting-periods. Of these two species Scudder says, "the larvæ remain within their dwellings, eating away the leaves that form them, until, having practically destroyed them, they are obliged to leave them and construct others; whilst many of the gregarious species, *e.g.*, the Melitæids, Vanessids, etc., utilise their common webs as feeding-places and hiding-places combined, continually extending their homes to take in new leaves, which, when partially eaten, become absorbed in the ever-growing mass of half-eaten leaves and frass which the web encloses. The larvæ of "skippers" also hide in specially prepared chambers between the times at which their meals are taken." Of the Vanessids, Powell notes (*in litt.*) that "the young larvæ of many species live and hide in webs, but when half-grown they rest exposed in groups, the members of a group feeding by day and resting almost simultaneously; later on, they scatter to a considerable extent, and especially is this noticeable in *Vanessa io* and *Aglais urticae;* the larva of *Polygonia egea* also feeds by day, resting exposed between its meals, whilst those of *Melitaea aurinia* and *M. cinxia* live when young in a web, feeding outside and resting and sunning during the day, and seeking the shelter of the web in bad or cloudy weather, and at night; when older they still feed by day and rest on stems of their foodplants, etc., fully exposed, whilst the larvæ of *M. didyma* and *M. deione* also feed by day, exposed, but usually hide during the resting-periods between their meals on the undersides of leaves."

The second resting-period of butterfly larvæ to be noticed is that connected with the exuviation of the larval skin. This is often a most exhausting process and considerable care is exercised by the larvæ in the choice of a suitable place for the purpose, so that, whilst the larva is in the tender stage of a new skin, accident shall not befall it, nor shall it be conspicuous to the enemies always ready to devour it. Hence, after a larva is fullfed in a certain stage, a place of safety has to be sought, and a silken platform spun, in which the prolegs are securely fixed, so that no injury due to slipping or falling may take place. Usually this resting-period lasts from two to three days, during which time the new larval skin, and its attendant structures, are formed beneath the old skin, the lubricating fluid between them is developed, and the final process of exuviation and after-rest, during which the skin is hardening, take place.

The period of rest varies in connection with each moult, and usually takes much longer in cool weather than in warm. Thus the larva of *Charaxes jasius* rarely occupies more than two days in moulting during summer, whilst, in winter, it falls little short of a week. The larva of *Erebia zapateri*, at its 1st moult, occupied from January 31st to February 6th, 1906, whilst for the 4th moult, in April, it occupied only four days. The first moult of *Papilio machaon* takes fully two or three days, the later moults perhaps a little less, the larva of *Papilio alexanor* occupies on an average about two days (Powell); the moults of *Pontia daplidice* are, as a rule, very rapid; one larva settled down at noon, September 9th, 1906, moulted 10 a.m., September 10th, 1906, and started to feed about noon, in no case did any moult for this species occupy 48 hours, and a larva spun up for change on one day had always moulted before the expiration of the following day (Sich); the 3rd moult of a larva of this species occupied only one day,

September 3rd-4th, 1882, the 4th moult occupying two days, September 8th-9th to September 10th-11th (Buckler); the average resting-period of *Colias edusa* at a moult is about two days, and so on. As to the exhausting nature of the moult in the larva of *Dryas paphia*, Buckler notes that one, that moulted April 29th, 1877, waited four hours before moving, and then hid itself under another leaf, remaining there without further movement for 29 hours more; a later moult in May took some days, the larva being fixed for the process on May 20th, the actual moult not taking place until May 25th.

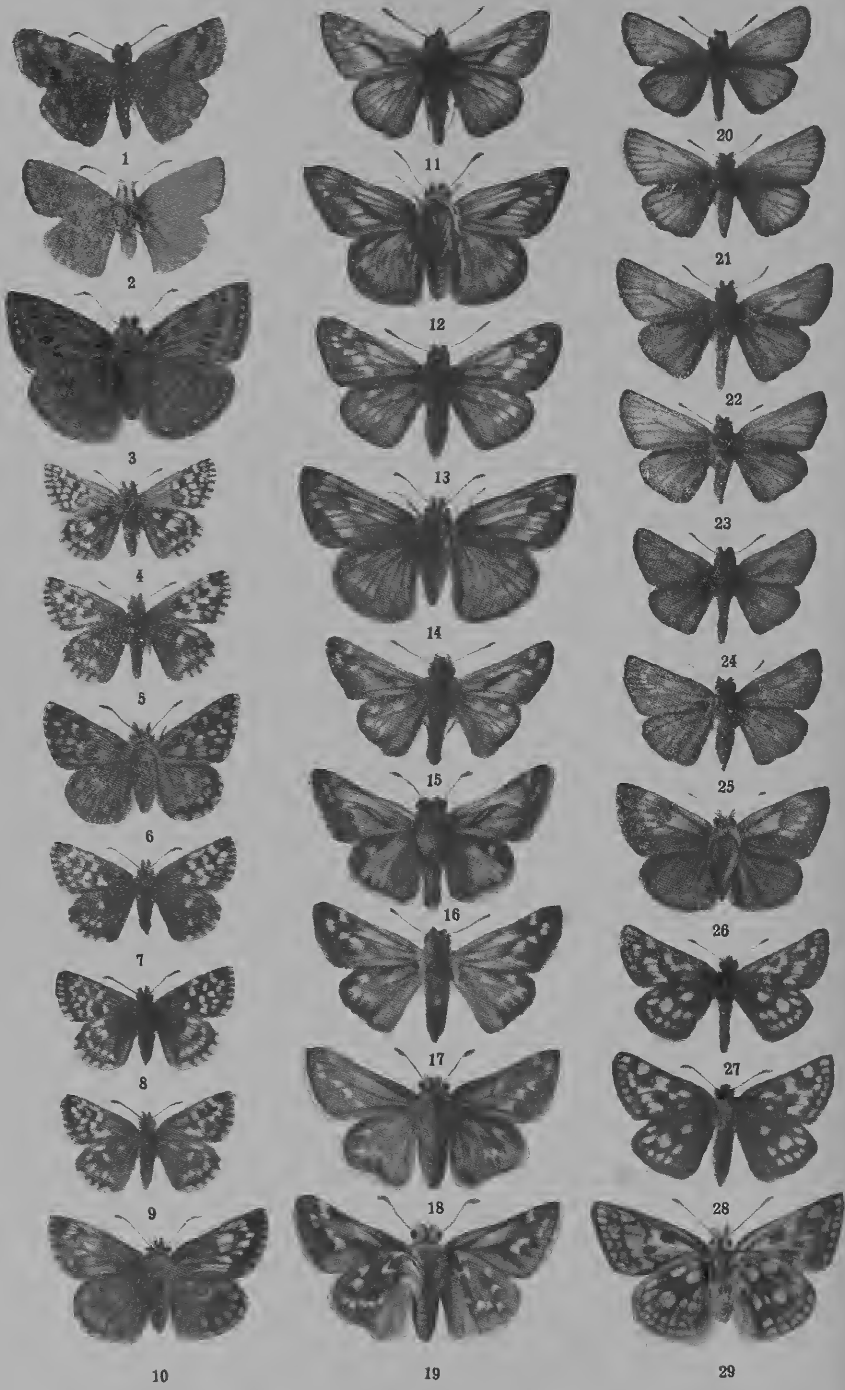
Scudder says that the moult from larva to pupa occupies a greater time than the moult from one larval stadium to another. This is, perhaps, pretty generally the case, but by no means always so, for, whilst the larva of *D. paphia* takes at least from four to six days' rest for its ordinary larval moult, it rarely takes more than 24 hours after suspension, when fullfed, before pupation takes place, *e.g.*, a fullfed larva suspended June 8th, 1877, pupated June 9th; a similar rapidity is noticeable in *Brenthis selene*, a larva of which suspended itself on August 6th, and pupated August 7th, 1870; and larvæ of *Melitaea athalia* suspended on May 24th-25th, pupated May 26th-27th. Similarly larvæ of *Papilio machaon* have a somewhat short quiescent stage preceding pupation, the larva resting about one and a half days from the time that the girth is spun and the position for pupation taken up, before assuming the pupal stage. Also, larvæ of *Pieris napi* spun up on July 4th-5th, 1874, became pupæ on July 6th-7th, and the larva of *Leptidia sinapis* also takes two days after spinning up before pupation actually occurs (Buckler). A larva of *Pontia daplidice*, had spun its silken platform and was spinning its girth at 4.20 p.m. on September 20th, 1906; by 5.5 p.m. the girth was finished, and, after inspecting the bosses, it settled down to rest for pupation; the resting-period lasted till 5 p.m. on the 22nd; the larva becoming a pupa between 5 p.m. and 6 p.m. In the evening of June 4th, 1906, a larva of *Pieris brassicae* selected a spot for pupation and spun part of its platform; at 10 a.m. on the 5th, the platform was finished, the girth spun, and the larva had entered the resting-stage; at noon, on the 7th, the larval skin had just been cast and pupation completed. On the evening of June 10th, 1906, two larvæ of *Pyrameis cardui* were spinning silk ready for pupation; at 7 a.m. on the 11th, they were both hanging from their silken pads, between 2 a.m. and 10 a.m. of the 12th, both had changed to pupæ (Sich); another larva of *P. cardui*, fullfed on October 10th, suspended itself on the 11th, and became a pupa on the 13th; a larva of *Euvanessa antiopa*, fullfed July 30th, suspended itself on the 31st, and pupated August 2nd (Buckler).

In none of these has the quiescent resting-period, preceding pupation, lasted more than two days. The larva of *Limenitis sibylla*, however, has a quiescent period of three days, whilst that of *Apatura iris* has one of four days. The fullfed larva of *L. sibylla* suspends itself by the anal prolegs, hangs with its body downwards in a sinuous curve, with its head bent a little upwards, remains motionless for three days, then, swinging itself to and fro and stretching downwards, the larval skin splits and pupation takes place. The fullfed larva of *Apatura iris* spins a large pad of silk under a leaf to which it attaches itself by its anal prolegs, remains motionless for about four days, when it releases its hold, hangs suspended, pupation taking place in about an

hour. In other cases, this period is a much longer one. Thus we note that larvæ of *Enodia hyperanthus* remain in the resting quiescent stage preceding pupation fully a week (*Ent. Rec.*, viii., p. 166), whilst Buckler records that four days elapse, from the time that the larvæ of *Pararge egeria* lose their longitudinal lines and become pale in tint, until pupation takes place. Larvæ of *Colias edusa*, spun up on October 15th, 1877, did not pupate until October 22nd, and larvæ of *Celastrina argiolus*, fullfed on June 20th, changed colour at once, but did not pupate until June 25th, whilst, in the autumn, a larva of this species, fullfed on September 10th, fixed itself on September 13th, but did not pupate until September 17th, the resting-period lasting in this case fully a week.

The resting-period of some other butterfly larvæ, in the quiescent stage preceding pupation, is really very remarkable, and may extend to as much as five-sixths of the whole period of the individual life. Others have a long period, without being, however, so excessive, *e.g.*, larvæ of *Hesperia malvae*, fullfed at the end of August, lie nearly quiescent for a period of about three weeks before the cocoon is spun and pupation takes place (see *anteà* p. 232), although Sich notes that, once the cocoon is spun, pupation takes place in three days (*anteà* p. 240). The larvæ of *Nisoniades tages* are fullfed at the end of July, when they spin their cocoons, and, in this, which serves as a hybernaculum, lie quiescent all the winter and spring, pupating in April and May. The larvæ of *Cyclopides palaemon*, spin their cylindrical sheath-like cocoons in mid-October, and, like the larvæ of *Nisoniades tages*, use these for hybernacula, pupating therein the following March or April. Most remarkable, however, is the larva of *Cupido minima*, which, fullfed at the end of July, takes up a position where it is well out of sight, and, practically without movement, remains in this place until the end of May or commencement of June in the next year, when pupation takes place after a larval resting-period of fully ten months.

It was intended to deal also with the larval resting-habits known as aestivation and hybernation, but these must form the subject of another chapter.




THE BRITISH URBICOLID BUTTERFLIES.

*Natural History of British Butterflies*, July, 1906.

## Plate VIII.

*(To be bound facing Plate VIII.)*

Urbicolid imagines.

| | |
|---|---|
| 1. Nisoniades tages ♂. | 16. Urbicola comma ♂. |
| 2. ,, ,, (underside). | 17. ,, ,, ♀. |
| 3. ,, ,, ♀. | 18. ,, ,, ♀. |
| 4. Hesperia malvæ. | 19. ,, ,, (underside). |
| 5. ,, ,, | 20. Adopæa lineola ♂. |
| 6. ,, ,, | 21. ,, ,, ♀. |
| 7. ,, ,, | 22. ,, flava ♂. |
| 8. ,, ,, | 23. ,, ,, ♀. |
| 9. ,, ,, | 24. Thymelicus acteon ♂. |
| 10. ,, ,, | 25. ,, ,, ♀. |
| 11. Augiades sylvanus ♂. | 26. ,, ,, ♀. |
| 12. ,, ,, ♂. | 27. Cyclopides palæmon ♂. |
| 13. ,, ,, ♀. | 28. ,, ,, ♀. |
| 14. ,, ,, ♀. | 29. ,, ,, (underside). |
| 15. Urbicola comma ♂. | |

## Superfamily I: URBICOLIDES (HESPERIIDES).

The "skipper" butterflies, as this superfamily is popularly called, form a very distinct and separate group of the Rhopalocera, and are considered by most of our best authorities—Speyer, Chapman, Reuter, etc.—not only as equal in classificatory value to all the other butterflies, but as forming a transition to the Heterocera. It certainly appears that the Urbicolid imagines exhibit many generalised characters in certain details of their structure. Among others may be noted—(1) The possession of an attachment (tibial epiphysis) to the anterior tibiæ. (2) The presence of two pairs of spurs on the posterior tibiæ (a peculiarly marked moth character) in several groups of the superfamily. (3) The possession of a fully-developed retinaculum, or catch-bristle, on the hindwings of certain species—*Euschemon rafflesiae*, etc.—usually referred to the Urbicolids. (4) The brush of stiff hairs springing from the base of the antennæ. (5) The peculiar mode of rest, the wings sometimes depressed roof-like, in *Nisoniades tages*, horizontally in *Erynnis* (*Carcharodus*) *altheae*, etc. (6) The generalised form of the neuration. (7) The peculiar structure of the basal-fleck of the labial palpi, etc.

The "epiphysis cruralis" or "tibial epiphysis" of the anterior tibiæ, is a bare, blunt, lancet- or thorn-shaped chitinous projection, which arises from the inner side of the tibiæ and reaches to their termination; it lies quite close to the tibia, and its free surface is clothed with a flat tuft of hairs, so that it is sometimes not easily recognised. It appears to be present in no other group of Rhopalocera except the Papiliones (*sens. strict.*). No group of butterflies except the Urbicolids appears to have two pairs of spurs on the posterior tibiæ. The brush of hairs at the base of the antennæ, called by some authors the "locklet," lies between them and the upper margin of the eyes, almost in the place occupied by the ocelli, but a little farther forwards, *i.e.*, near the middle of the base of the antennæ, the ocelli, when present, lying on the posterior margin. It is developed alike in both sexes, but varies in length, form and colour, in different genera and species.

The basal-fleck or basal-spot at the base of the labial palpi, differs very markedly in structure from that of the other Rhopalocera, always occupying a much larger area (*Ent. Record*, x., pl. i., fig. 6), whilst the chitinous cones, which are unusually small, and irregularly and diffusedly distributed, are covered with very peculiar modified hair-structures, which occur only in the Hesperiids (Urbicolids). None of the different characters already mentioned as being characteristic of all the other Rhopalocerous divisions are found in this group. The basal-fleck, indeed, as well as the palpi of the Hesperiids, represents a type quite different from that of the other butterflies, a view which is confirmed by several other characters (Reuter, *Ent. Record*, x., p. 96).

The secondary sexual characters exhibited by the imagines are also interesting, and, in some cases, striking. The most noticeable are—(1) The "costal fold" in the ♂s of certain Hesperiines. (2) The conspicuous "discal cell" or "discoidal stigma" in which the ♂

androconial cells are situated in certain Urbicolines. (3) The brush of hairs sometimes developed in the ♂ s on the hindmost tibiæ. (4) The metasternal appendages, the "postpectus" of Kirby, developed on the venter of the thorax. (5) The "abdominal fossa," a more or less extensive excavation on the side of the anterior abdominal segments. It is to be noted that the presence or absence of these characters appears to be somewhat capricious. The ♂ s of some apparently closely-allied species have, whilst others have not, the costal fold, and the same is true of the discal androconial cell, *e.g.*, *Nisoniades tages* has, and the allied *marloyi* has not, a costal fold.

The superfamily is generally known as the *Hesperiides*, a name derived from the Fabrician *Hesperia*, but it is difficult to understand why the much older Linnean name has been passed over, for, in 1758, Linné separated (*Systema Naturae*, xth ed., p. 482) the smaller butterflies—hairstreaks, blues, coppers and skippers—under the title *Plebeii*, and further subdivided (*op. cit.*, pp. 482, 484) them into the *Rurales* and *Urbicolae*, the latter being, even at this time, absolutely restricted to the "skippers." Pallas, in 1771, Fabricius, in 1775, 1781 and 1787, and Esper, in 1776, maintained the Linnean name. In 1780, Goeze called them the *Urbicolae*, and in 1781, Barbut, using *Urbicola* in a truly modern generic sense, fixed the type of the genus as *comma*, Linn., no. 256,* whilst, in 1788, Borkhausen subdivided the Linnean *Rurales* into the *Subcaudati* (hairstreaks), *Rutili* (coppers), and *Polyophthalmi* (blues), keeping, however, the Linnean name *Urbicolae* for the skippers, whilst, more important than all, Fabricius himself, in separating the Linnean *Plebeii* from the rest of the butterflies, and renaming the group (*Ent. Syst.*, iii., p. 258), in 1793, *Hesperia*, retained the Linnean subdivisions, calling the blues, etc., the *Hesperia-Rurales*, and the skippers the *Hesperia-Urbicolae*. So far, therefore, as Linné's group names—*Papilio*, *Nymphalis*, *Plebeius*, *Ruralis*, *Urbicola*, etc.—have any classificatory and nomenclatorial value, it is clear that the "skippers" must be called the *Urbicolides*, and its typical genus, of which Barbut named *comma*, Linn., no. 256. the type, *Urbicola*.

In 1798, Cuvier fixed (*Tabl. Elem.*, p. 588) *malvae*, Linn., as the type of *Hesperia*, Fab., although it may be further noted that Fabricius' later action (*Illiger Magazin*), in 1807, shows conclusively that he did not consider the *Urbicolae* of Linné a typical section of his comprehensive group *Hesperia*, for he himself restricted the name to a group of blues, of which *boeticus* is one of the best-known species, creating *Thymele* and *Pamphila* for the skippers, and dropping the hitherto-used *Urbicola* altogether.

It is remarkable that, besides the unanimity with which the early authors used the Linnean name, *Urbicola*, for the skippers, there was really no attempt to classify them until Hübner did so in 1816. In 1801, Schrank renamed (*Fauna Boica*, ii., pt. 1, p. 157) the *Urbicolae* of Linné, *Erynnis* (including *malvae* (*alceae*), *fritillum*, *tages*, *comma*, *linea*, *speculum*), and, in 1805, Latreille (*Hist. Nat. Crust. et Ins.*) called them *Hesperia*, carrying out for the first time Cuvier's restriction of Fabricius' name for Linné's *Plebeii*, and divided them into two groups—

* It is unfortunate that Barbut after fixing the type of *Urbicola* as *comma*, Linn., no. 256. described and figured *flava* (*thaumas*) as *comma*, a blunder that does not, however, vitiate his action in fixing *comma*, Linn., as type.

EGGS OF BRITISH URBICOLIDES (SKIPPERS).

## Plate I.

*(To be bound facing Plate I.)*

Eggs of Urbicolids.

Fig. 1.—Thymelicus acteon.

Fig. 2.—Adopæa lineola.

Fig. 3.—Augiades sylvanus (from Bourg St. Maurice).

Fig. 4.—Augiades sylvanus (from Essex).

Fig. 5.—Urbicola comma.

Fig. 6.—Cyclopides palæmon.

All $\times 20$ diameters.

1. Hindwings not elongated into a tail—*Hesperia malvae*, *tages*, *fritillum*, *paniscus*, *comma*, *aracinthus*.
2. Hindwings elongated into a tail—*Hesperia proteus*.

In 1806, Hübner created (*Tentamen*, p. 1) the group and generic names, *Urbani* and *Urbanus*, giving as type *Urbanus malvae* (*alceae*), whilst, in 1807, Fabricius, as already noted, separated (*Ill. Mag.*, vi.) the superfamily into two groups :

1. *Thymele*—*a*. Wings tailed—*Hesperia proteus*, *mercatus*, *acastus*.
   *b*. Wings untailed—*Hesperia thrax*, *gnetus*, *bixae*.
   *c*. Wings rounded—*Hesperia aracinthus*, *malvae*, *tages*.
2. *Pamphila*—*Hesperia comma*, *paniscus*, *fritillum*, *lavaterae*, etc.

In 1816, Hübner, as usual far ahead of his time, gave a very comprehensive grouping of all the species then known, under the name *Astyci*, which he states = *Urbicolae*, Linn., Fab. (*Verz.*, pp. 102 *et seq.*). The part of his grouping that concerns us is as follows :

Fam. IV : Veteres—
  Coitus 3 : Nisoniadæ—*Nisoniades bromius*, Stoll., *N. mimas*, Cram., *N. zephodes*, Hb., *N. juvenis*, Hb. (*juvenalis*, Abb.), *N. tages*, Linn., *N. aurispex*, Hb., *N. ophion*, Stoll.
Fam. V : Vulgares—
  Coitus 1 : Pyrgi—*Pyrgus syrichtus*, Fab. (*orcus* fig. J, Cram.), *P. oilus*, Linn. (*tartarus*, Hb.), *P. orcus* figs. K, L, Cram., *P. sidae*, Esp., *P. tessellum*, Hb., *P. carthami*, Hb. (*alveus*, Hb.), *P. fritillum*, Schiff. (*malvae*, Linn.), *P. alveolus*, Hb. (*malvae*, Esp.), *P. sertorius*, Hb. (*sao*, Bergst.), *P. vindex*, Cram.
Fam. VI : Cauti—
  Coitus 3 : Carcharodontes—*Carcharodus lavatherae*, Esp. (*tages*, Sulz.), *C. altheae*, Hb., *C. malvae*, Schiff. (*alceae*, Esp.).
Fam. VII : Vigilantes—
  Coitus 2 : Cyclopidæ—*Cyclopides steropes*, Schiff. (*aracinthus*, Fab.), *C. brontes*, Schiff. (*paniscus*, Fab.), *C. silvius*, Knoch, *C. metis*, Linn., *C. coras*, Cram.
  Coitus 5 : Augiadæ—*Augiades crinisus*, Cram., *A. arcalaus*, Cram., *A. comma*, Linn., *A. sylvanus*, Esp., *A. helirius*, Cram., *A. euribates*, Cram.
  Coitus 6 : Thymelici—*Thymelicus actaeon*, Esp., *T. pustula*, Hb., *T. vibex.*, Hb., *T. venula*, Hb., *T. virgula*, Hb., *T. vitellius*, Hb., *T. linea*, Schiff. (*thaumas*, Esp.), *T. puer*, Hb.

Scudder divided (*Butterflies of New England*) the superfamily into two tribes only—the *Hesperiidi* and the *Astyci*. These two groups, as represented by their typical species in Europe, differ widely, not only in the imaginal characters, but also in the early stages, the eggs being as widely different, and very parallel in their differences, as are those of certain Nymphalids and Satyrids—the former having conical, longitudinally ribbed eggs ; the latter more or less spherical and pitted eggs (the ribs being obsolete). Watson says the characters of the egg, larva, and pupa are subsidiary, and of a slight and ill-defined character. On the contrary, there are few superfamilies in which such a wide range of marked characters presents itself in the early stages. There can be no manner of doubt whatever about the importance of the differences between the ribbed Hesperiid egg (*e.g.*, *Hesperia malvae*, *Nisoniades tages*, etc.), the Urbicolid egg (*e.g.*, *Urbicola comma*, *Augiades sylvanus*, etc.), and the very moth-like Thymelicid egg, *Adopaea flava*, etc.), which, although possessing three axes of different lengths, yet has the micropylar axis at right angles to the surface on which the egg is laid, and might be considered as forming a transition between a typical flat and an upright egg, but is possibly a further development from an ordi-

nary upright egg. In separating the Hesperiids and Astycids (Urbicolids), Scudder notes many points of difference, the chief of which he describes as follows:—"In the ♂ Hesperiids the posterior extremity of the alimentary canal is protected beneath by a corneous sheath, which extends beyond the centrum or body of the upper pair of abdominal appendages, sometimes nearly to the extremity of the appendages, carrying the vent beyond the centrum, whilst in the *Astyci* the extremity of the canal is not protected by any extruded sheath, but opens at the very base of the inferior wall of the centrum" (*Bull. Buff. Soc. Nat. Sci.*, i., 195).

To the two groups here suggested Scudder has since accepted a third, called, by Mabille, *Pyrrhopygini*, from the *Pyrrhopygae* of Hübner (*Verzeichniss*, p. 102). These three main groups, evidently of full family value, are defined on their imaginal characters, as subfamilies, by Watson (*Proc. Zool. Soc. Lond.*, 1893, pp. 9 *et seq.*) as follows:

I. Pyrrhopyginæ.—A well-marked group of closely-allied genera confined entirely to the New World; readily recognised by the large blunt club to the antennæ, which is a constant character. The cell of the forewing invariably very long, more than two-thirds the length of the costa. Nervure 5* of the forewing usually nearer to 4 than 6. At rest all the wings extended horizontally.

II. Hesperiinæ.—Includes all species with a costal fold in ♂; all species in which nervure 5 of the forewing is nearer to 6 than to 4, and all species which rest with their wings extended horizontally. Some few species rest with their wings raised above the back, but these are very few and can invariably be recognised by the costal fold or by some other character, also, in a considerable number of genera in which the cell is more than two-thirds the length of costa, nervure 5 is usually slightly nearer to 4 than to 6, occasioned by the upper angle of cell being produced and the middle discocellular consequently elongated. These genera, however, are readily recognised by the length of the cell as in the *Pamphilinae*, where it is only in a very few well-marked genera that the cell exceeds two-thirds of the costa. The antennæ almost without exception end in a fine point, and, in the few genera in which this is not the case, the cell is invariably short.

III. Pamphilinæ.—Includes all species with a discal band on the forewing of the ♂, and all species in which nervure 5 of the forewing is nearer to 4 than to 6, with the exception of those noted above. When in a complete state of repose all the species of this group rest with their wings raised over their backs; but when only sunning themselves, in many species the forewings are elevated and the hindwings depressed. The cell of the forewing is almost invariably less than two-thirds the length of the costa, and the antennæ almost invariably end in a fine point.

Of these we have species belonging to the last two groups in the British Islands.

In order to obtain a clear idea of the names rightly applicable to the various genera, we have made a first-hand study of the subject with the following result. We have not given all our results, but the fixing of the types of the following Urbicolid genera appears to be of importance to the students of the Palæarctic fauna:

1758. Urbicola [Linné], Barbut.—Type fixed in 1781 by Barbut as *comma*, Linn.

1793. Hesperia, Fab.—Type fixed in 1798 by Cuvier as *malvae*, Linn.

1801. Erynnis, Schrk.—Type fixed in 1820 by Oken as *alceae*, Esp. (*malvae*, Schrank).

1806. Urbanus, Hb.—*Malvae*, Hb. (=*alceae*, Esp.), the only species mentioned, and therefore the type. Consequently falls before *Erynnis*, Schrank.

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* The nervures are numbered from the lower part of wing upwards, nervure 1 being the anal nervure (the nervure from base to anal angle of wing).

1806. Heteropterus, Dum.—Type fixed in 1823 by Dumeril as *morpheus*, Pallas, which he figures.

1807. Thymele, Fab.—Contains *malvae*, Linn. (under the name *lavaterae*), the type of *Hesperia*, Fab., before which it therefore falls.

1807. Pamphila, Fab.—Type fixed in 1840 by Westwood as *comma*, Linn., the name, therefore, falls before *Urbicola* [Linn.], Barbut.

1815. Thymale, Oken.—Used for several groups of species. Evidently a *laps. cal.* for *Thymele*, Fab., a synonym of *Hesperia*, Fab.

1816. Nisoniades, Hb.—Type fixed in 1834, and confirmed in 1850, by Stephens as *tages*, Linn.

1816. Pyrgus, Hb.—Type fixed in 1834, and confirmed in 1850, by Stephens as *alveolus*, Ochs. = *malvae*, Linn. Falls. therefore, as a synonym of *Hesperia*, Fab.

1816. Carcharodus, Hb.—Typical coitus of *Urbanus*, Hb., containing *malvae*, Hb. (= *alceae*, Esp.), which therefore becomes the type, the genus falling before *Urbanus*, Hb., and *Erynnis*, Schrk.

1816. Cyclopides, Hb.—Restricted in 1834 by Stephens, to *paniscus*, Fab., and *sylvius*, Knoch. Type fixed in 1850 by Stephens, and confirmed by Westwood and Hewitson in 1852, as *paniscus*, Fab. (= *palaemon*, Pallas).

1816. Augiades, Hb.—Restricted, in 1834 and 1850, by Stephens to *comma*, Linn., and *sylvanus*, Esp. Type fixed by Scudder in 1872 as *sylvanus*, Esp. [Butler's action, in 1870, of overriding Stephens' restriction of 1850, is *ultra vires*.]

1816. Thymelicus, Hb.—Restricted in 1850 by Stephens to *thaumas*, Hufn., and *acteon*, Rott. (also in 1834 under the laps. cal. *Thymelinus*). Under the same misspelling, in 1858, Kirby fixed the type as *acteon*, Rott.

1820. Adopæa, Billbg.—Created for *thaumas*, Hufn., and a MS. species, the former, therefore, becoming the type. Type confirmed in 1893 by Watson.

1832. Steropes, Bdv.—Name preoccupied in Coleoptera (Stev., 1806).

1832. Thanaos, Bdv.—*Tages*, Linn., was figured in 1836, by Boisduval under this name. Type specified as *tages*, Linn., by Blanchard, in 1846; the name, therefore, falls as a synonym of *Nisoniades*, Hb.

1832. Syrichtus, Bdv.—Restricted in 1840 by Blanchard to *malvae*, Hb. (*alceae*, Esp.) and *alveolus*, Ochs. (= *malvae*, Linn.). "Anon," in 1841, in the *Isis*, cites only *malvae*, Linn., which therefore becomes the type. Falls as a synonym of *Hesperia*.

1834. Thymelinus, Stphs.—A misprint for *Thymelicus*, Hb. The misspelling repeated by Kirby, in 1858, when *acteon* was cited as the type. Falls before *Thymelicus*, Hb.

1844. Spilothyrus, Dup.—Created for *alceae*, Esp., *altheae*, Hb. and *lavatherae*, Esp. Contains *alceae*, Esp., the type of *Erynnis*, before which it falls, all three species being congeneric.

1852. Carterocephalus, Led.—Proposed to replace *Steropes*, Bdv., preoccupied. Type fixed in 1867 by Snellen as *palaemon*, Pallas. It falls, therefore, as a synonym of *Cyclopides*, Hb.

In dealing with the general biological structure of the Urbicolids we may consider the subject under the headings of egg, larva, pupa, and imago. The Urbicolid egg varies considerably. In its more typical form it is generally described as being rather more than hemispherical, with tough and opaque shell. This description would fit very fairly well the Urbicoline (Pamphiline) egg, *e.g.*, the group to which *Urbicola comma* and *Augiades sylvanus* belong, but it fails for the Hesperiine group as exemplified by *Hesperia malvae* and *Nisoniades tages*, in which there is considerable resemblance to the Nymphalid form of egg, *i.e.*, conical with definite and well-marked longitudinal ribs, and still more so for the Thymelicine egg, which, as we have noted, has the external facies of a "flat" egg with the vertical micropylar axis of a butterfly egg. The difference between these three forms of eggs is great. Possibly a wider knowledge of the egg characters in this superfamily will modify our present opinion as to other groups.

The Urbicolid larva is also very characteristic. It is particularly noticeable for its large head, its constricted prothorax, giving it much the appearance of a neck, its uniform cylindrical shape from

mesothorax to 8th abdominal, marked subspiracular flange, the generalised nature of the secondary hair-clothing, the specialised nature (or obsolescence) of the tubercles and tubercular setæ, and the hiding habits it affects, forming silken tubes in which to conceal itself whilst feeding. Here again, however, there are considerable differences in structural details, and these, apparently, of a most important nature, although at present little understood. Some of these peculiarities are (1) the spiracle-like tubercles known as lenticles, (2) the arrangement of the hooklets of the prolegs, and (3) the "white scaly excrescences" developed on the 7th and 8th abdominal segments in certain Urbicoline (Pamphiline) larvæ. Of the "lenticles," Chapman, in describing the larva of *Erynnis* (*Spilothyrus*) *lavatherae*, notes (*Ent. Rec.*, xv., pp. 298-300) that "these lenticles may represent the true tubercles, but by no means certainly so. On the abdominal segments, on the 1st subsegment, a little outside the mediodorsal black line, is a raised, dark chitinous circle, without any hair, and looking almost exactly like a spiracle; this might be tubercle i. On the yellow lateral flange, at its most prominent portion, a little in front of the middle of the segment, is another exactly similar chitinous ring, but paler, *i.e.*, brownish in colour. These from their form, colour and position, might easily be supposed to be the spiracles, but are perhaps tubercle iv. A single similar circle is found on the left side of the 2nd abdominal segment, above and in front of the spiracle, which might be iii, but no other exists in this position on any other segment. The lenticles that appear to represent i, and are on the 1st subsegment of the abdominal segments, exist on the 2nd subsegment of the meso- and metathorax." Reference to our detailed descriptions of the larvæ of the British species should be made, where other facts relating to these peculiar structures may be noted. In the abdominal prolegs of the larva there are some structural variations in the hooklets. In other butterfly larvæ the hooks exist, as in the Macro-Heterocera, only along the inner margin of the originally circular pad. In the Urbicolids the circle of hooks usually remains in the adult larvæ, as in the Micro-Heterocera. In some species, for example, *Cyclopides palaemon*, there is a simple circle, or rather an oval, with a gap on the inner side; but in many of the species, chiefly among the Urbicolids (*comma*, *sylvanus*, etc.), there is a complete circle, repeated in three rows, the outer row having the smallest hooks. This latter form is met with elsewhere only in Hepialid larvæ, and is, therefore, a very archaic form of proleg. Taking *Erynnis lavatherae* as a type of the Hesperiine larva, Chapman notes that the inner posterior margin is furnished with numerous hooks, apparently alternating in two sizes; round the anterior margin they become much more sparse, so that, from the middle of the anterior to the middle of the outer margin they can be easily accounted as being five, hence, on the outer and back margins, for about one-fifth of the circumference, they are quite wanting. The anal prolegs form a disc of three-quarters of a circle, the chord of which forms its posterior border; this border has no hooks, the rest carries hooks, the outer half ten large ones and intermediate smaller ones; on the inner half they are much more crowded and numerous." The most remarkable structures presented by the larvæ are the "white scaly excrescences" which are present in the larvæ of most Urbicolids (Pamphilids). These usually snow-white patches

gradually develop under the epidermis during the growth of the larva in its last larval instars, and are mature, so to speak, when the larva is quite ready for pupation. They are placed on the underside of the 7th and 8th abdominal segments, and Rühl states that the excrescence in *Urbicola comma* is "somewhat leaf-shaped, thick and viscous," that "on the application of heat it melts like wax and therewith loses its white colour entirely." It appears that these are in reality pockets of some waxy material, which the larva scatters when spinning its cocoon for pupation. It probably helps to make the cocoons watertight, a very necessary provision, considering the slenderness and usual position of the structures made by these caterpillars.

The Urbicolid pupæ vary much, and the main points of difference between the various groups are most marked, *e.g.*, Hesperiines, as represented by the thick, stumpy, rounded pupæ of *Hesperia malvae* and *Nisoniades tages;* the Urbicolines by the round-headed, long-tongued pupæ of *Urbicola comma* and *Augiades sylvanus;* the Thymelicines by the sharp-nosed pupa of *Adopaea flava* (*thaumas*), and the Cyclopidid by the slender, beaked pupa of *Cyclopides palaemon.* The mode of pupation in the Urbicolids is interesting. There is, first of all, the making of a loose silken puparium, in which pupation takes place. The Hesperiines (*Nisoniades tages*, etc.) appear not to have a cincture or girth, although they cling most tenaciously to the inside of the silken cocoon by means of the cremastral hooks, and it would appear that the Urbicolines (*Urbicola comma*, etc.) also have none, whilst the Thymelicids and Cyclopidids suspend themselves by an anal pad and fine body cincture in the puparia they construct. Among other butterflies whose larvæ spin a cocoon are the Parnassiids, a group of butterflies far removed from the skippers.

Of the imaginal characters—to some of which reference has already been made—the secondary sexual characters of the ♂, the antennæ, the structure of the legs, and the neuration, are all characteristic. The *Megathymidae* (*Megathymus* and *Ægiale*) are sometimes included in the superfamily, as also is the Australian group, *Euschemonidae* (*Euschemon*), in which the imago is furnished with a frenulum—a character supposed to be absolutely distinctive of Heterocera. Their close alliance with the Urbicolids is, however, very problematical. Of the secondary sexual characters—(1) The costal fold of the ♂ as seen in *Hesperia malvae* and *Nisoniades tages*, etc. (2) The discal "stigma" or "brand" of the ♂ as exhibited in *Adopaea lineola, Urbicola comma*, etc. (3) The tuft of ♂ hairs as seen in *Isoteinon atkinsoni*, etc.—it is to be observed that the costal fold is characteristic of the Hesperiids, the discal streak or stigma to the Urbicolids (*sens. restr.*), etc. It may also be here noted that in the Old World there are few species of Hesperiines (*i.e.*, with the costal fold on forewings) compared with the much greater number of Urbicolines (*i.e.*, with a discal stigma), whilst, in the New World, the numbers of the two groups seem to be much more equal. There appear to be species in both groups with other ♂ characters—tufts and patches of modified androconial scales on underside of forewing, or on upper- and underside of hindwings, or on legs, that is, these are not peculiar to either group. Certain of the Urbicolid wing-plumules, *i.e.*, the special androconial scales found in these specialised wing areas of the males, have been described and figured by Aurivillius

(*Ent.*, xxxvi., pp. 228-230), and the differences they present are very interesting. He describes them as:

1. "Plumulæ subulatæ" or "Bristle plumules," in which the end is produced into a single bristle. Found in the costal fold in *Hesperia malvae*.

2. "Plumulæ capillares" or "Hair bristles," slender, fine as a hair, obtuse at end. Found in costal fold of *Nisoniades tages* [also on upperside of wings of many Lycænid species].

3. "Plumulæ articulatæ" or "Jointed plumules," slender, nearly smooth, divided into many joints, easily separable from one another. These are the remarkable scales which are so closely packed together in the ♂ discal sacs of the true Urbicolids (Pamphilids), *e.g.*, *Urbicola comma*.

The "tibial epiphysis," to which reference has already been made, appears to be a very marked character in some genera, variable in others, being present in some species and absent in closely allied ones, whilst it is even said to be present in some, and wanting in other, individuals of the same species, *e.g.*, *Abantis tettensis*. It may here be noted that, although the terminal and median spurs are usually present on the hind tibiæ, the pair on the middle tibiæ is sometimes absent. Watson considers this character to be usually of generic value, although, in certain Cyclopidines, he holds the presence or absence to be of specific value only.

The antennæ vary much, the apical portion being markedly different in shape in different groups. The club may be "hooked" when its terminal portion is bent to less than a right angle with the remainder of the club, or "sickleshaped" when the whole of the club is evenly curved and not abruptly angled, or "bent" when the club is abruptly angled but not hooked. Jordan describes (*vide Ent. Record*, xi., p. 86) four different kinds of special organs and structures as being present on butterfly antennæ, *viz.*, "scales," "fine sense-hairs," "setiferous punctures," and "sense-bristles." He also draws particular attention to the special "form of antennal joints." His summary of the characters presented by the Urbicolid (Hesperiid) (*sens. lat.*) antenna reads as follows:—"A typically Hesperiid character is the ventral widening of the joints of the club, giving it the well-known hook of that family. The joints are cylindrical, without raised lines or grooves. The scaling is very extended, covering the whole dorsum except, in rare instances, the last joint; the ventral surface is also scaled, except a greater or less portion of the club. There are no setiferous punctures, the bristles appear to be typically on the non-scaled area, a transverse row of seven, usually apical, but may be reduced even to two lateral ones." Chapman observes (*loc. cit.*, p. 123) that "the Urbicolids (Hesperiids), in preserving a very complete coating of scales, are only illustrating their relationship to the earliest lepidoptera. There is much reason to believe, on antennal evidence, that the Lycænids and Urbicolids originated in a common ancestor before either group was clearly defined, in which the terminal antennal joints probably possessed dorsally both hairs and scales. On the Hesperiid antenna the hairs vanished, the scales persisted; in the Lycænid antenna the scales disappeared and the hairs persisted. Chapman thinks that the ancestral Lycænid had scales on the dorsal aspect of the terminal joints, and, in fact, all over the ventral surface also, whilst there seems nothing to prevent the hypothesis being held that the dorsal hairs have maintained their position right through, from the scaleless antenna of the non-lepidopterous ancestor, and

have not necessarily migrated from below (the Hesperiid position), supplanting scales; but, if so, scales were certainly once associated with them.

Of the nervures, there are twelve in the forewing (1-12) and nine in the hindwing (1*a*, 1*b*-8), 1 in each case being the anal nervures. They branch directly from the discoidal cell, and not from one another. In the *Hesperiidae* (*sens. strict.*) nervure 5 (from the middle of the outer boundary of cell) is nearer to 6 (from top outer corner of cell) than to 4 (from lower corner of cell) when the cell of the forewing is less than two-thirds the length of the costa, and only nearer to 4 when the cell is more than two-thirds the length of the costa. In the *Urbicolidae* (*Pamphilidae*), nervure 5 is never nearer to 6 than to 4 (except in a few aberrant Australian genera), and is usually very much nearer to 4, whilst, on the other hand, the cell of the forewing never exceeds two-thirds of the length of the costa (except in one or two Asiatic genera). The presence or absence of nervure 5 in the hindwing is very variable, in some cases being fully developed, in others only traceable as a fold, whilst in some Urbicolids (Pamphilids) (chiefly those in which nervure 5 of the forewing is very close to the bottom of the cell) it is absolutely invisible (Watson).

The chief characters of the superfamily in its various stages appear to be as follows:

EGG.—Varying from flat to approaching spherical; shell tough and opaque; surface comparatively smooth or ribbed.

LARVA.—Head large; the prothorax very narrow and forming a distinct neck; prolegs provided with a circle of hooks, often complete and multiple; construct a slight cocoon in which to pupate.

PUPA.—The 7th abdominal segment (in addition to the 5th and 6th) not apparently free in ♂, but has the appearance of having recently been so; thoracic spiracle exceedingly conspicuous; dorsal head-piece persistent; the eye-plates dorsal; eye-plates on dehiscence separate from ventral head-parts, but continue attached to dorsal head-piece; terminal joints of maxillary palpus persist as minute eye-collar.

IMAGO.—Head broad; eyes glabrous; with overhanging brush of hairs; antennæ very far removed at bases; club of antennæ large, strong; basal joint with long hair-tuft; anterior legs fully developed in both sexes, posterior tibiæ usually with middle pair of spurs; forewings with nervures separate; hindwings with nervure 5 variable.

The peculiar variation in the resting-habit of the superfamily has been already noticed. *Nisoniades tages* rests upon flowers, etc., by night, with the wings sloping downwards, like those of a Noctuid moth. Similarly, Zeller has noticed that freshly-emerged imagines of *Erynnis malvarum* (*lavatherae*) rest with the wings closed in this manner, the antennæ being placed sideways and laid along the thorax, and the abdomen turned upwards, and we have noticed the imagines of *Erynnis altheae* resting with the wings placed horizontally and the abdomen turned up in a somewhat similar manner. Many of the species, however, rest with the wings over the back in the usual fashion adopted by butterflies. Among our few British species there is considerable variation in the imaginal habits. They are all of small size and of unattractive colours. Their flight is short, quick, and jerky, whence they get the name of "skippers." They dart swiftly in the hot sunshine from flower to flower, or sun themselves on leaves and stones, or suck up water from the roadside rills, bathing as it were in the steamy atmosphere arising when the hot sunshine falls on the trickling water. We have observed as many as 100 or more *Hes-*

*peria* (*Syrichtus*) *alveus* in one such patch of not more than a foot square. Most of the British species are common, or locally abundant. *Hesperia malvae* abounds in woods, fields, and on grassy banks in May and early June, and, at the same time, *Nisoniades tages* is to be found on chalky and limestone hillsides, openings in woods, etc., among bird's-foot trefoil. At the end of May, in early seasons, the abundant *Augiades sylvanus* makes its appearance, and the local *Cyclopides palaemon* abounds in a few localities in Lincolnshire, Northamptonshire, etc. In July, *Adopaea flava* (*thaumas*) appears, and the more local *A. lineola* abounds in some localities, favouring, apparently, in our islands, the southeastern seacoast, whilst at the same time the allied *Thymelicus acteon*, even more local, is confined to the steep slopes of the southwestern seacoast. In August, *Urbicola comma* is common locally on chalk and limestone formations, whilst, occasionally, second-brood specimens of *Nisoniades tages* appear in warm seasons. If the collector want *Thymelicus acteon*, *Adopaea lineola* and *Cyclopides palaemon*, he must of course visit their special haunts, otherwise, in the more favourable British localities, he may reasonably hope to take the others, if he collects pretty widely, in his first or second season.

The superfamily has a world-wide distribution, but the number of species inhabiting the Palæarctic region is exceedingly small, The species of the Nearctic and Palæarctic areas are very similar, but the former possesses quite twice as many species as the latter. It is, however, essentially a tropical superfamily—South America being particularly rich in the number of its species.

## Family: Urbicolidæ.

This family is of world-wide distribution, and, so far as the Palæarctic species are concerned, is readily divisible into at least two very distinct subfamilies—the *Thymelicinae* and *Urbicolinae*. The *Thymelicinae* fall near the *Urbicolinae* in their imaginal characters, but in the egg stage appear to form a group, quite distinct from the others. Roughly the family coincides with Hübner's Fam. G—*Vigilantes*, Coitus 4-7, *viz.*, *Phemiadae*, *Augiadae*, *Thymelici*, *Apausti*, and part of the *Brontiadae* (*Verz.*, pp. 111-113). In this family, the ♂ has never a costal fold on the forewing, but, usually, there is a marked discal pocket on the forewings filled with strikingly specialised androconial scales, and making a conspicuous black streak across the wing. Throughout the family, the epiphysis on the tibiæ of the first pair of legs appears to be invariably present, thus agreeing with the Amblyscirtid group of the Cyclopidids, the typical tribe of the latter, *Cyclopididi*, being without them. On the tibiæ of the hind legs both pairs of spurs are invariably present, and there is never a tuft of hair on the front tibiæ of the ♂. The two subfamilies, *Thymelicinae* and *Urbicolinae*, are comprised in Watson's *Pamphilinae*, sect. B (*Proc. Zool. Soc. Lond.*, 1893, p. 70). The *Ismenidae*, another allied family, corresponding with Watson's *Pamphilinae*, sect. C (*op. cit.*, p. 70), have no Palæarctic representative, and its relationship with *Urbicolidae*, as exhibited in the early stages, has not yet been worked out. Watson's diagnosis of the family (as *Pamphilinae*, sect. B) reads as follows:

Antennæ very varied but never hooked; the club either entirely without, or with, a crook of varying length. Palpi with third joint in several genera long,

slender, and curving over the vertex (a character never found in the *Hesperiinae*); in most of the other genera the third joint is minute, only very rarely being horizontally porrected, and, when this is the case, it is always stout. Forewing: cell invariably less than two-thirds the length of costa; vein 5 curves downwards at its base and consequently arises considerably nearer to 4 than to 6; the middle discocellular being considerably longer than the lower one, frequently more than twice as long as it. Hindwing usually rather elongate, but never with a conspicuous tail or tooth; vein 5 very rarely developed. The male is frequently furnished with a discal stigma on the forewing and never with a costal fold. Both pairs of spurs are invariably present.

When absolutely at rest, the butterflies hold the wings erect over the back, but, when sunning themselves, they have a peculiar habit of elevating their forewings and depressing the hindwings, in contradistinction to the Hesperiids proper, which sun themselves with the wings fully expanded.

## Subfamily: Thymelicinæ.
### Tribe: Thymelicidi.

A thorough knowledge of the egg-stage of the Urbicolids will have to be obtained before the limits of this group can be determined. The whole of the butterfly stirps has hitherto been defined as having an upright egg, *i.e.*, an egg with a circular transverse (horizontal) section, and the micropylar axis perpendicular to the plane of attachment. Careful examination of the eggs of *Thymelicus acteon*, *Adopaea flava* (*thaumas*) and *A. lineola*, has led to the discovery that they are, in almost all their essential characters, butterfly eggs in the strict sense, but they have three axes of different lengths, so that the horizontal section of the egg is not circular, whilst, in agreement with the true butterfly egg, one finds that the micropylar axis is at right angles to the plane of attachment. This suggests most strongly that the Thymelicines may be, at least, in this respect, a specialised (and not primitive)* form of the Urbicolids, and it affords a sure test by which they may be separated from the Urbicolines and Cyclopidines, both of which have true upright butterfly eggs with smooth unribbed shells.

Hübner's coitus *Thymelici* is defined as having—

The wings almost entirely yellowish and unspotted—*Thymelicus actaeon*, Esp., Pap. 36, 4; Hübn., Pap. 488-490; *T. pustula*, *T. vibex*, *T. venula*, Hübn., Pap. 665-669; *T. virgula*, Hübn., Pap. 660-663; *T. vitellius; T. linea*, Schiff., Verz., Pap. A. 5 (*thaumas*, Esp., Pap. 36, 2-3; Hübn., Pap. 485-487); *T. puer*.

Speyer diagnoses (*Can. Ent.*, x., p. 151) the Thymelicids as having:

The antennæ half as long as the forewings, with elongate, ovoid, conically-tipped club. Apical joint of the palpi nearly erect, moderately long and slender, subulate, hidden to beyond its middle by the long stiff hairy clothing of the middle joint. Middle tibiæ with a longitudinal series of short spines. Hindwings somewhat produced at the inner angle. Male with a discoidal stigma, without a costal fold, and without a tibial tuft.

Speyer further notes that the tribe differs from the *Pamphilidi* (= *Urbicolidi*) in the slender, subulate apical joint of the palpi, and in the absence of the hooklet on the end of the antennal club. The club, however, is somewhat elongate, and thus differs from the Urbicolines in which the tip is acuminate and the club usually short and stout and with a short terminal crook. Rühl further also points out (*Pal. Gross-Schmett.*, p. 636) that the apical joint of the palpi is not

* Chapman observes (*in litt.*) in connection with this point that, whilst "an egg may vary the length of an axis, it cannot move its micropyle from the end to the top, whilst retaining the primitive form."

only tolerably long and slender, but is almost perpendicularly set, awl-shaped, and surrounded for half its length by the adornment of the middle joint consisting of long, stiff bristles. The relationship of Hübner's *Apausti* (*Apaustus menes*, Cram.) with the Thymelicids still needs determination. Reference should be made to Watson's synoptical key of this group, sect. B, *a* (*Proc. Zool. Soc. Lond.*, 1893, pp. 90-91).

We have already pointed out (*anteà*) the peculiar character of the Thymelicid egg, but, even in those of our three British species, there is some difference, for that of *Adopaea flava* (*thaumas*) is more oval than those of *A. lineola* and *T. acteon*. The eggs of *A. lineola* and *A. flava* are distinctly flat eggs in shape, the upper surface being somewhat hollowed; on the other hand, the egg of *T. acteon* is more dome-shaped, and hence rather nearer the typical butterfly egg in appearance. Its surface, too, approaches that of the Urbicolids (*e.g.*, *Augiades sylvanus*), for both *T. acteon* and *A. sylvanus* have an embossed or raised network thrown, as it were, over the egg, with raised bosses where the lines cross each other. The egg of *A. flava* has this raised network in a very modified form, the lines being very fine and only slightly raised above the surface. In *A. lineola* the network is formed merely by the ridges of the shallow pits which cover the egg, and has not the appearance of a real net thrown over the egg. The sculpture and domed shape of the egg of *T. acteon*, make this egg form, indeed, a sort of primary transition to those of the Urbicolines, although, no doubt, further discoveries in this direction are to be made by any lepidopterist who has the chance of making observations on other Thymelicid and doubtful Urbicoline species. The following comparison, made by Sich, is worthy of careful study :—

| | Flat Eggs. | | Domed Egg. |
|---|---|---|---|
| | *lineola.* | *flava.* | *acteon.* |
| Length .. .. .. .. | 1·04mm. | 0·92mm. | 1·20mm. |
| Breadth .. .. .. .. | 0·66mm. | 0·75mm. | 0·72mm. |
| Height .. .. .. .. | 0·37mm. | 0·40mm. | 0·54mm. |
| Proportion of breadth to length | 1 : 1·57 | 1 : 1·22 | 1 : 1·7 |
| Proportion of height to length | 1 : 2·8 | 1 : 2·3 | 1 : 2·2 |
| Proportion of breadth to height | 1 : 1·8 | 1 : 1·875 | 1 : 1·3 |

From this it will be seen that *acteon* has the largest egg, *lineola* the narrowest egg and *flava* (*thaumas*) the roundest egg. The chief comparative characters of these eggs appear to be as follows:—

*Acteon*—May be at once recognised by the network sculpture, the lines of the reticulations being raised above the general surface, and not merely the margins of the shallow pits.

*Flava*—Different in shape (roundish-ovoid instead of an elongate-ovoid); the sculpture of shallow pits as in *lineola*, but the pits smaller and the reticulations more raised. The micropylar rosette cells differ also in being rather pointed, in *acteon* and *lineola* rounded at their extremities.

*Lineola*—Smaller than *acteon*, the sculpture consisting of shallow pits, rather than a raised network.

## Genus: Adopæa, Billberg.

Synonymy.—Genus: **Adopæa**, Billbg., "Enum. Ins.," p. 81 (1820); Scudd., "Hist. Sketch," p. 103 (1875); Wats., "Proc. Zool. Soc. Lond.," p. 98 (1893); Kirby, "Handbook," etc., p. 20 (1897); Grote, "Proc. South Lond. Ent. Soc.," p. 59 (1897); Staud., "Cat.," 3rd ed., p. 92 (1901);

Lambill., "Pap. Belg.," p. 270 (1902). **Papilio**, Brünnich, "Pont. Danske Atl.," i., p. 685 (1763); Scop., "Ent. Carn.," p. 181 (1763); Hufn., "Berl. Mag.," ii., p. 62 (1766); Schiff., "Schmett. Wien.," 1st ed., p. 160 (1775); Rott., "Nat.," vi., p. 4; xx., p. 133, pl. ii., figs. *a-b* (1775); Müll., "Zool. Dan. Prod.," p. 115 (1776); Schneider, "Sys. Besch. Eur. Schmett.," p. 273 (1785); Geoff., "Fourc. Ent. Par.," p. 246 (1785); Lewin, "Insects," etc., p. 94, pl. xlv., figs. 5-7 (1795); Hb., "Eur. Schmett.," pl. xcvi., figs. 485, 486 (♂), 487 (♀) (1802), text, p. 72 (*circ.* 1805); Hb., "Larvæ Lep.," i., Pap. II., Gens Ec, figs. 2*a-b*, (*circ.* 1800); Ill., "Schmett. Wien.," 2nd ed., ii., p. 146 (1801); Ochs., "Die Schmett.," i., pt. 2, p. 288 (1808); Freyer, "Neu. Beitr.," vii., p. 55, pl. 631, fig. 1 (1842). [**Papilio-**] **Urbicola**, Bork., "Sys. Besch.," i., pp. 181, 285 (1788); ii, p. 236 (1789). [**Papilio-Plebeius-**] **Urbicola**, Esp., "Schmett. Eur.," i., pl. xxxvi. (supp. xii.), figs. 2-3 (1777), pl. xcviii. (cont. lii.), figs. 5-10 (1785); Goeze, "Ent. Beit.," ii., pt. 3, p. 114 (1780); Bergs., "Nomenclatur," etc., p. 38, pl. xc., figs. 5-8 (1780); Barb., "Gen. Ins. Linn.," p. 173, in part, descr. (1781); Fab., "Mant.," ii., p. 84 (1787); Scriba, "Journal," iii., pp. 244-7 (1791); Haw., "Lep. Brit.," p. 51 (1803). [**Hesperia-**] **Urbicola,** Fab., "Ent. Sys.," iii., p. 326 (1793). **Erynnis**, Schrank, "Faun. Boica," ii., pt. 1, p. 159 (1801). **Hesperia,** Latr., "Consid. Gen.," p. 208 (1810); Leach, "Edin. Encycl.," ix., p. 130 (1815); Ochs., "Die Schmett.," iv., p. 34 (1816); Dalm., "Vet. Ak. Handl.," iv., p. 34 (1816); Latr., "Enc. Méth.," p. 770 (1819); Sam., "Ent. Comp.," p. 242 (1819); Godt., "Hist. Nat.," i., p. 233, pl. xii., fig. 3, pl. xii tert., fig. 2 (1821); Bdv., "Eur. Lep. Ind. Meth.," p. 27 (1829); Meig., "Eur. Schmett.," p. 69, pl. lvi., figs. 4*a-d* (1830); Bdv., "Icon. Chen.," pl. 1, figs. 5-6 (1832); Treits., "Die Schmett.," x., i, pp. 97, 248 (1834); Bdv., "Gen. et Ind. Meth.," p. 35 (1840); Dup., "Cat. Meth.," p. 35 (1840); Evers., "Faun. Volg.-Ural.," p. 87 (1844); H.-Sch., "Sys. Bearb.," i., p. 159 (1846); Dup., "Icon. Chen.," p. 212, pl. xxxi., fig. 89 (1849); Led., "Verh. zool.-bot. Ges.," ii., p. 26 (1852); Speyer, "Geog. Verb.," i., p. 288 (1858); Hein., "Schmett. Deutsch.," p. 117 (1859); Staud., "Cat.," 1st ed., p. 15 (1861); Wallgrn., "Skand. Dagf.," p. 258 (1853); Snell., "De Vlind.," p. 87 (1867); Nolck., "Lep. Fn. Estl.," p. 83 (1868); Newm., "Brit. Butts.," p. 174 (1869); Staud., "Cat.," 2nd ed., p. 35 (1871); Mill., "Cat. Lep. Alpes-Mar.," p. 116 (1872); Curò, "Bull. Soc. Ent. Ital.," vi., p. 216 (1874); Frey, "Lep. Schweiz.," p. 54 (1880); Lang, "Butts. Eur.," p. 350, pl. 81, fig. 9 (1884); Kane, "Eur. Butts.," p. 146 (1885); Dale, "Brit. Butts.," p. 215 (1890); Barr., "Lep. Brit. Isl.," p. 275, pl. xxxviii., figs. 1-1*e* (1893). **Pamphila**, Oken, "Lehrb. Zool.," p. 759 (1815); Stephs., "Ill. Brit. Ent.," p. 101 (1828); "Sys. Cat.," p. 27 (1829); Wood, "Ind.," p. 9, fig. 78 (1839); Humph. and Westd., "Brit. Butts.," p. 129, pl. xli., figs. 8-12 (1841); Dbldy., "Syn. List," p. 2 (1850); Westd. and Hewits., "Gen. Lep.," p. 522 (1852); Sta., "Man.," i., p. 68 (1857); Kirby, "Eur. Butts.," p. 122 (1862); Stphs., "List," 1st ed., p. 22 (1850); 2nd ed., p. 21 (1856); Butl., "Cat. Diurn. Lep.," p. 277 (1869); Kirby, "Eur. Butts.," p. 66 (1882); Buck., "Larvæ," etc., i., pp. 139, 195, pl. xvii., fig. 3 (1886); Meyr., "Handbk.," p. 358 (1895). **Thymelicus,** Hb., "Verz.," p. 113 (1816); Auriv., "Nord. Fjär.," p. 39, pl. vii., fig. 14 (1889); Rühl, "Pal. Gross-Schmett.," pp. 638, 828 (1895); Tutt, "Brit. Butts.," p. 139 (1896); Reutti, "Ent. Rec.," x., p. 97 (1898); Wheeler, "Butts. Switz.," p. 10 (1903). **Thymelinus,** Stphs., "Ill.," iv., p. 405 (1834); Kirby, "Syn. Cat.," pp. 609, 829 (1871). **Heteropterus,** Ramb., "Faun. And.," p. 306 (1839); "Cat. Lep. And.," p. 87 (1858).

The genus *Adopaea* (or *Adopoea*) was created in 1820 by Billberg (*Enum. Ins.*, p. 81) for *flava* (*thaumas*) and a MS. species, so that *flava* was the undoubted type. It has since been described (*Proc. Zool. Soc. Lond.*, 1893, p. 98) by Watson under this name, with *flava* (*thaumas*) as the type, as follows:—

Antennæ short, less than half the length of costa; club elongate, straight or slightly arcuate, tip blunt. Palpi: second joint clothed with laxly-set scales; third joint long, slender, suberect. Forewing: inner margin longer than outer margin; cell less than two-thirds the length of costa; middle discocellular more than twice as long as lower; vein 5 from close to bottom cell; vein 3 close to end of cell; vein 2 (in both sexes) slightly nearer to base of wing than to end of cell. Hindwing: outer margin even, slightly excised at vein 2; vein 7 well before end of cell, only slightly nearer to 6 than to 8; discocellulars very faint, vein 5 not traceable; vein 3 immediately before end of cell; vein 2 more than twice as far

from base of wing as from end of cell. Hind tibiæ with two pairs of spurs. Abdomen slender, extending beyond anal angle of hindwings. Male with a linear discal stigma on the forewing in two portions—the upper portion long, lying below the inner margin of cell, from the origin of vein 3 to as far as vein 2; the lower portion short, in continuation of the upper portion, from below vein 2 to not quite as far as vein 1. (Antennæ and palpi figured, *op. cit.*, pl. iii., fig. 27.)

There are only two British species in the genus, *viz.*, *flava*, Brün. (*thaumas*, Hufn.) and *lineola*, Ochs. They differ from *Thymelicus* (as exemplified by *acteon*) in having a much flatter egg, being very flat above and beneath, the upper surface indeed being slightly hollowed, whilst that of the latter is dome-shaped and much more nearly approaching that of *Augiades* (*sylvanus*), the sculpture, too, is much more definitely marked in *Thymelicus* than in *Adopaea*. Too little is known of the larval and pupal stages of the species in these genera to make any comparison, but, in the imaginal stage, considerable differences exist, and the wing-markings of *Thymelicus* already indicate those of *Augiades* and *Urbicola*.

### Adopæa lineola, Ochsenheimer.

Synonymy.—Species: **Lineola,** Ochs., "Die Schmett.," i., pt. 2, p. 230 (1808); iv., pp. 34, 161 (1816); Latr., "Enc. Meth.," p. 771 (1819); Bdv., "Eur. Lep. Ind. Meth.," p. 27 (1829); Meig., "Eur. Schmett.," p. 68, pl. lvi., figs. 5*a*-*d* (1830); Bdv., "Icones Hist.," p. 243, pl. xlvii., figs. 4-5 ♀ (1832); "Icon. Chen.," pl. i., figs. 3-4 (1832); Dup., "Hist. Nat.," supp. i., p. 253, pl. xli., figs. 1-3 (1832); Treits., "Die Schmett.," x., pt. 1, p. 248 (1834); Ramb., "Faun. And.," p. 306 (1839); Bdv., "Gen. et Ind. Meth.," p. 35 (1840); Dup., "Cat. Meth.," p. 35 (1840); Evers., "Faun. Volg.-Ural.," p. 88 (1844); H.-Sch., "Sys. Bearb.," p. 159 (1846); Westd. and Hewitsn., "Gen. Diurn. Lep.," p. 522 (1852); Led., "Verh. zool.-bot. Gesell.," ii., p. 26 (1852); Speyr., "Geog. Verb.," p. 288 (1858); Ramb., "Cat. Lep. And.," p. 87 (1858); Hein., "Schmett. Deutsch.," p. 118 (1859); Staud., "Cat.," 1st ed., p. 15 (1861); Kirby, "Eur. Butts.," p. 122 (1862); Wallgrn., "Skand. Dagf.," p. 257 (1853); Snell., "De Vlind.," p. 87 (1867); Nolck., "Lep. Fn. Estl.," p. 83 (1868); Kirby, "Syn. Cat.," pp. 609, 829 (1871); Staud., "Cat.," 2nd ed., p. 35 (1871); Curò, "Bull. Soc. Ent. Ital.," vi., p. 216 (1874); Kirby, "Eur. Butts.," p. 66 (1882); Frey, "Lep. Schweiz," p. 54 (1880); Lang, "Butts. Eur.," p. 351, pl. 81, fig. 10 (1884); Kane, "Eur. Butts.," p. 147 (1885); Auriv., "Nord. Fjär.," p. 39 (1889); Hawes, "Entom.," xxiii., p. 3 (1890); Dale, "Brit. Butts.," p. 229 (1890); Wats., "Proc. Zool. Soc. Lond.," p. 9 (1893); Barr., "Lep. Brit. Isl.," p. 279, pl. xxxviii., figs. 2-2*d* (1893); Rühl, "Pal. Gross-Schmett.," p. 636 (1895); Meyr., "Handbook," &c., p. 358 (1895); Tutt, "Brit. Butts.," p. 135 (1896); Kirby, "Handbook," etc., p. 21 (1897); Staud., "Cat.," 3rd ed., p. 92 (1901); Lamb., "Pap. Belg.," p. 267 (1902). **Linea,** Scriba, "Journal," iii., pp. 244-7 (1791). **Virgula,** Hb., "Eur. Schmett.," pl. 130, figs. 660-3 (1808).

Original description.—P. alis integerrimis divaricatis fulvis concoloribus, fœminæ immaculatis, maris lineola nigra tenuiore. [Scriba, *Journal*, iii., p. 244.] I consider this insect, often confused with *linea*, a distinct species. Size and shape of *P. linea*, but the forewings rather broader and more obtuse; the colour paler, and reddish-yellow. The male has, on the forewings, a straight black line, as fine as a hair, and the club of the antenna is black beneath, whereas it is always rusty-yellow in *P. linea*. The underside of the forewings is uniform reddish-yellow, the hindwings (beneath) are paler, almost whitish-yellow, towards the inner margin pale yellow. The above-mentioned characters appear to be sufficient to entitle this butterfly to be considered a good species. As it is found in several parts of Germany along with *P. linea* at the same season, it cannot be considered an aberrant second brood. Scriba (*Journal*, iii., p. 244, *Entomolo-*

*gische Bemerkung*) has given a complete comparative description of the two butterflies * (Ochsenheimer, *Die Schmett.*, i., pt. 2, p. 230).

IMAGO.—Expanse 22mm.-28mm. All the four wings of an orange-fulvous colour, without spots; the outer margin distinctly black-banded; this and the outer edge of the nervures darker, and more pronounced than in *A. flava* (*thaumas*) which it somewhat resembles; ♂ with fine black androconial mark on forewings; fringes pale ochreous. The antennæ black-tipped. The underside greyish-yellow, the hindwings particularly uniformly tinted and without the bright patch at the anal angle that characterises *A. flava*.

SEXUAL DIMORPHISM.—The male is similar to the female, except that it possesses a very slender black mark or androconial pocket in which the black androconia or ♂ scent-scales are packed. This is situated directly beneath and in contact with the median nervure, and is not turned down at its basal end, as in *A. flava*. The females appear to be distinctly paler in the ground colour than the males, to have a cleaner dark marginal border, thus contrasting more strongly, and are usually slightly larger and of heavier build. The ♂ androconial mark varies somewhat, a small separate piece extending parallel to the main dash at its lower point; this forms Staudinger's ab. *semicolon*. The androconial scales are really "fine hairs, much shorter than those of the other species, from 0·13mm.-0·18mm. long, and 0·0034mm. broad; the segments are less completely formed, so that the joints are more rarely separated from one another. Really fan-shaped scales do not seem to occur" (Aurivillius).

COMPARISON OF ADOPÆA LINEOLA AND A. FLAVA.—Upperside: *A. lineola* is smaller than *A. flava* (*thaumas*), the ♂s with a much finer, shorter, and altogether more indistinct, androconial streak that does not turn down towards the inner margin of the wing at its termination, but is sometimes interrupted there; the black margins broader, their inner edges gradually shading off into the ground colour; the neuration darker and the nervures more distinctly marked than in *A. flava*. Underside: the tips of the antennæ black beneath, not fulvous or yellowish-red as in *A. flava*; the hindwings uniformly coloured, the inner margin not more brightly fulvous, as is the case in *A. flava*. Boisduval (apparently at first quoting Ochsenheimer) adds that the fringe of *lineola* is whiter, the upper wings rather wider and more rounded at the extremity, the extremity of the nervures not only blacker but slightly dilated; the underside of the hindwings of the ♂ whitish-yellow, of the ♀ greyish-white with the abdominal margin "plus clair."

VARIATION.—There is a fair amount of difference in the colour tint of various specimens, some having distinctly more yellow in the ground-colour. Our British examples otherwise exhibit but little variation. We also possess some specimens with pale blotches in the wing, showing local failure of pigment development, such aberrations being undoubtedly pathological. In its various localities, however, on the

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* Ochsenheimer is quite correct in referring this species to Scriba as its first describer. He calls it *linea* and gives a most careful comparison between it and *thaumas*. His name *linea*, having already been used for *thaumas* (=*flava*), of course falls. His description is as follows:—" *P. P. Urbicola linea*: Alis integerrimis fulvis immaculatis, lineola tenuiore nigra in alis superioribus maris, apicè antennarum nigro" (*Journal*, iii., p. 247).

Continent, it offers considerably more variation; this runs in three directions—(1) In the tint of the ground-colour which extends from (*a*) Clear golden-brown, with clear-cut, narrow, black margin = ab. *clara*, n. ab., from Larche, Useigne, Courmayeur, Val Véni, etc., where it appears to be largely a racial form, and Megève, Grand Salève, etc., where it occurs as an aberration. (*b*) Deeper orange-fulvous, with broader marginal band, fading more into ground-colour = type (*lineola*, Ochs.). (*c*) Deep chocolate-brown, a very rare form = ab. *brunnea*, n. ab., which we have only seen in odd specimens from Bourg St. Maurice and Chamonix. (2) In the intensity and width of the black marginal area, the intensity of the nervures, the lining in of the discoidal lunule with black and the suffusion of the hindwings. These characters in their extreme development form no doubt *ludoviciae*, Mabille, but an intermediate form with very well-developed (but not extreme) margins and nervures and without the discoidal lunule black (= ab. *suffusa*, n. ab.), is still more frequent, although both are common enough in many of the mountain localities we have visited. (3) In size, the examples from Wolfsberg, Lamsdorf, and Villach being particularly striking; these are of full colour, almost deep brown in tint, extending (♂ and ♀) 32mm.-33mm. in expanse of wing = ab. *major*, n. ab. Nicholson notes this form at Buda-Pest, where he says it is "larger than average *A. thaumas*," and we have equally large forms from Grésy-sur-Aix and Macugnaga. A pale form (parallel in colour with ab. *clara*) of the same large size comes from Tragacete in Spain. It may be called ab. *major-clara*, n. ab. The examples from the Simplon and the average specimens from Macugnaga are somewhat intermediate in size, 30mm.-31mm., but have the heavier build of ab. *major*, rather than that of the type = ab. *intermedia*, n. ab. The following are the already described forms—

α. ab. *pallida*, Tutt, "Brit. Butts.," p. 136 (1896); "Ent. Rec.," xiv., p. 113 (1902); Wheeler, "Butts. Switz.," p. 10 (1903). *Lineola* var., Carr., "Ent.," xxix., p. 68 (1896).—A pale straw-coloured aberration found occasionally in both sexes. Flies with the type.

Carrington records (*Ent.*, xxix., p. 68) lemon-coloured forms from Shoeburyness, perhaps referable to this aberration. This yellow form was first figured by Bergstrasser, in 1780 (*Nomenclatur*, pl. 128, figs. 3-4). Oberthür notes (*in. litt.*) that he has a ♀ from Silesia, the body and wings entirely of a white colour, tinged with yellowish.

β. ab. *semicolon*, Staud., "Iris," v., 282 (1892); Rühl, "Pal. Gross-Schmett.," i., p. 637 (1895); Tutt, "Brit. Butts.," p. 136 (1896); Wheeler, "Butts. Switz.," p. 10 (1903).—Comparatively small, the borders rather darker, the males with a rather broader band of androconial scales, and the short dash at its base more distinctly black. Algerian examples, corresponding with this description, have been distributed by us, as var. *semicolon*, but the differences are so small that the name seems hardly worth retaining (Staudinger).

Wheeler notes that all his Swiss examples show some slight traces of this streak, and certainly a very large percentage of those in our collection do so; we have the form represented from many localities.

γ. ab. *ludoviciae*, Mab., "Ann. Soc. Ent. Belg.," p. 118 (1883); Lang, "Butts .Europe," p. 351 (1884); Kane, "Handbook," p. 146 (1885); Rühl, "Pal. Gross-Schmett.," i., p. 637 (1895); Staud., "Cat.," 3rd ed., p. 92 (1901); Wheeler, "Butts. Switz.," p. 10 (1903).—*Pamphila ludoviciae*, n. sp. *P. lineola*, Ochs., minor et ei proxima, sed habitu gracili, statura et colore diversa. Intense aut obscure fulva. Alæ anticæ late nigromarginatæ, cum ramis nigro-scriptis; nervula discoidalis nigra cellulam claudens; lineola nigra, maris indicium, exilis, nervo parallela. Alæ posticæ fulvo-nigrantes,

raro fulvæ, marginibus late infuscatis. Alæ anticæ subtus apice nigranti margine interno nigro, parte interiori alæ nigra; posticæ fuscescentes, squamis nigris creberrimis consitæ, spatio anali sordide luteo-fusco. Cætera ut in *P. lineola.* E. Gallia in Montibus Arverniæ (Murat) et Pyrenais (Mabille).

Mabille further notes that, although near *lineola*, *ludoviciae* is a fifth less in size*; the male of a "fauve rouge" tint, the border wider, and all the nervures marked with black, the discoidal cell closed by a markedly black nervule; the hindwings often entirely suffused with brown, and so appear to be of a different tint from the forewings; on the underside, the hindwings are of a deep olive-grey, powdered with black scales, whilst the cellule of the forewings is closed by a black streak. The female is slightly larger and yellower than the male. The Pyrenean examples (Val d'Eyna) are a little paler, and are lacking in the black lunule at end of cell, described as being present in those from Murat. Other minor differences occur, but are difficult to describe. The tip of the antennal club is black as in *lineola*, whilst the ♂ sexual streak is rather narrower and longer than in the latter insect. A specimen from the Alps was also observed in Fallou's collection. We have ourselves taken exceptionally dark specimens on the Simplon, and Agassiz reports it for the Haut Valais.

Egglaying.—Eggs received from Mr. Whittle on July 22nd, 1905, laid in confinement the preceding day; two laid on a flowering spike of *Lolium perenne*, were quite exposed, four on the spikelets of the flowering stem of *Cynosurus cristatus*, three of which were well hidden by the scabrid glumes of the grass and the fourth partly hidden. The exposed ones were laid quite closely together, whilst of the others, two were laid singly, and two, one on the other, touching each other. The eggs adhere only by a small portion of the base, that flat side of the egg opposite the micropyle (Sich and Tutt). Laid at the end of July and beginning of August on the blades of *Triticum* in confinement, in rows in the sheath formed by the culm and main stem of the blade. They are attached securely to the grass culm, and the embryo soon develops, but does not leave the egg till towards the end of April, when the larva eats its way out by means of a curiously-frayed opening in the shell (Hawes).

Ovum (pl. i., fig. 2).—A depressed ovoid egg, smooth to the unaided eye, pale yellowish or whitish-ochreous in colour, and, under a lens, appearing whiter and more opaque, the surface shining, slightly iridescent, and with a very distinct trace of fine pitting. Its shape (for a butterfly egg) most remarkable, being typically flat (and laid as a flat egg) with three axes of different lengths. In outline it inclines towards an almost true oval; the edges, however, looked at sideways, thicker than the centre of the egg, so that the upper and under sides are somewhat depressed, the edges themselves smoothly rounded (Tutt, July 22nd, 1905). The micropyle lies in the centre of the large, but not deep, basin on the upper surface of the egg; the walls rise gradually above this basin and are rounded off over the periphery towards the base, which is much less in area than the space enclosed by the periphery. Surface of the shell very minutely pitted. The sculpture consists of a slightly raised network, enclosing polygonal cells. These are mostly irregular pentagons, about 0·03mm. across,

* Mabille unfortunately gives no measurements of type or aberration, so that actual comparison is impossible.

but often diamond-shaped. The micropyle appears as a minute depression, encircled by eight small roundish cells, and these, again, are surrounded by about twenty larger roundish cells, which increase in size as they recede from the micropyle, and gradually lose themselves in the surface network. The surface of the shell is very finely striated, ray-fashion from the micropyle, and this striation sometimes extends over the entire micropylar basin. This striation is presumably only the above described minute pitting arranged lineally (July 23rd, 1905). The eggs show a dark blotch and a yellow tint, possibly the head and body of enclosed larvæ (August 4th, 1905) (Sich). A rounded oblong and flat, *i.e.*, like a bean—is of a pale straw-colour when first laid, the shell throughout, and even after the larva emerges, shining very much like mother-of-pearl. After about eight days, the colour changes from pale straw to a deep yellow, and from that, in about three weeks, or in about a month after being laid, to a dark leaden hue, and the young larva becomes plainly visible coiled on one side, the head being placed at one of the shorter sides, and in this state remains till the end of April. The egg-shell is stout and of close texture (Hawes).

Comparison of eggs of Adopæa lineola and Thymelicus acteon.—There are three specimens of the egg of *A. lineola*, and one of *T. acteon* for comparison. The form of the former egg is that of a typical flat egg (although it is not one), the length is 1·0mm., width 0·65mm., height 0·42mm. Seen from above it is of a very regular oval outline, but seen sideways it differs from that of *T. acteon* in being very flat above and beneath, and with rounded margins; *T. acteon* being, so far as its oval outline allows it, rather dome-shaped. Indeed, all the three specimens of *A. lineola* agree in the upper surface being slightly hollowed, which may be the normal form, but is more likely the result of shrinking by drying, as is so common in flat eggs of this form. The colour of the egg of *A. lineola* is that of the contained larva (?), greyish-yellow at one end, dark and light at the other. The sculpture is that of irregular polygons, very like those of *T. acteon*, but possibly a shade larger, say 0·035mm. in diameter, the lines of the mesh forming the netting are fainter, less raised and narrower than in *acteon*, and are without any knots or knobs at the intersections. The micropylar circle is rather larger than in *acteon*, and has a very definite rosette form, with two circles of petaloid cells round its outer margin. Its situation is in the centre of the upper flat surface (Chapman, September 11th, 1905).

Habits of larva.—The young larva leaves the egg about the middle of April (20th), and, taking up its position in the middle of a blade of grass, reaches its head to one side, scooping out small portions of the blade, but its evident wish for concealment leads it at once to draw the blade together by spinning silken threads over its back; its movements are at this time by no means slow, and, if disturbed, it curls up into a ring, from which the anal segments protrude. In nature, as distinguished from the larva of *A. flava* (*thaumas*), that of this species appears to lose none of its active upward movements, and may be found by a close search at dusk, and no doubt during the night, near the tops of the blades of grass. The larva appears to be a slow and deliberate eater, living as such from 8 to 10 weeks, and, when young, not only hides itself in the drawn-together blade, but has the power of letting itself fall by means of a thread from the mouth. It also frequently

retreats backwards down the cylinder thus formed of the blade (Hawes). Whittle found a larva at large at Canvey, on June 9th, 1897.

Ontogeny of larva.—*First instar:* When newly-hatched, in general shape, a miniature of the full-grown larva, thicker at the middle, and tapering towards the head and anal segments; colour, pale yellow; head and prothoracic plate black. *Second instar:* The head still black; the prothoracic plate decreasing in size; the colour of the body rather paler, and with an inclination towards the green of the later stages. (?) *Third instar:* The prothoracic plate has disappeared; the colour yellowish-green, having a rather broad dorsal stripe of darker green, which stripe is continued as a distinct brown mark over the head to the mouth; on each side of this brown mark the head is paler, being of a faint brownish tint; there are two thin subdorsal yellow stripes, and a light line traverses each side just below the spiracles; the segmental divisions are yellow, and the belly and legs of a deeper and clearer green. *Fourth instar:* The only difference noticeable is the more pronounced colouring, especially of the head, where, besides the central brown mark, two others, one on each side, are present. This, with the body of a clearer green, gives the larva a more attractive appearance than is usual among those of this family of butterflies. *Fifth instar:* The only change noticeable is a still greater intensity of the previous colour and markings; head pale yellowish with three brown lines (that of *H. thaumas* is of a whitish-green without lines); the colouring of the body now closely resembling that of a grass blade, and the brown striped head corresponding accurately with a withered tip of the blade. In this, and also in the previous skin, two white scaly excrescences are formed between the 4th and 5th (last) pair of prolegs, which are thrown off with each change of skin and forms afresh, being very noticeable in the fullgrown larva (Hawes).

Larva.—Body yellowish-green, and (viewed with a lens) strewn with black dots; four dorsal yellow longitudinal stripes, and a similar one above legs. Ventrally, on each of the two segments before the last, a white spot. On the middle of the head, two longitudinal stripes, bordered externally with brown. The white stigmata almost obsolete [De Graaf, *Herklot's Bouwstoffen*, i., p. 187. Described from larva found on sandy ground near Noordwijk, at the end of June, 1852.] The body fairly broad, with very plainly indicated segments. The ground-colour pale bluish-green. Dorsally, several longitudinal lines, *viz.*, a darker green mediodorsal line, on either side of this, first a yellow, then a green, then again a yellow, which is bordered by an extremely narrow, darker green, margin; the three central lines continued to the anus, but the two outer yellow lines ended at the last incision. On the side, at the height of the oblong, black, white-margined spiracles, is another yellow line, which first becomes really distinct on the fourth segment. The whole body was, on the upper surface, beset with short, rust-coloured hairs. The 2nd and 3rd segments showed, in the middle, a conspicuous transverse fold (see figs. 1 and 2).* The head was globose, yellow-green, with two divergent white lines, which, from the occiput, somewhat bent from below, passed along the third eyelets. Between these lines was the rose-red forehead, which colour also appeared as a narrow line between the

* The 1st segment is the prothoracic.

white line and the eyes. I find no mention of this red colour in the details of any description, it appears that there may be individual variations in the colour of the larvæ. On the underside, the body, with 16 feet, was also bluish-green. On the penultimate segment, one sees two square, clear, white marks, also on the third ring from the end is a white band in the form of two united halves. The last pair of feet were larger and broader than any of the abdominal pairs (see fig. 3). I had this larva figured on June 15th. It rested during the day with the head retracted. I did not notice that it ate much at night, and, on the 18th following, it had already pupated. [Snellen van Vollenhoven, *Sepp's Nederland. Insecten*, 2nd series, iii., p. 86. Described from larva found June, 1871, by Mr. H. W. de Graaf, feeding on a soft kind of grass with free, broad leaves. Figured at fig. 1.]

Foodplants.—Coarse grasses—*Arrhenatherum elatius*, etc. (Frey), *Triticum*, etc. (Hawes).

Puparium.—In nature the puparium appears to be made by the spinning up of blades of coarse grass. Such an one was found near Harwich, in July, 1891 (Mathew). In confinement, the larva, when full-grown, spins the grass-stems together low down by means of a network of white silk, changes to pupa therein, and in this state remains for about a fortnight to three weeks, according to temperature (Hawes). Snellen van Vollenhoven notes (*Sepp's Ned. Insecten*, 2nd series, iii., p. 86) that a larva spun up in confinement on June 16th, 1871, fastening itself firmly with a slight spinning to the paper with which the top of the bottle, in which it was confined, had been closed. The fixture of the pupa consisted only in some cross-threads over the anterior extremity, and some confused spinning in which the anal extremity was barely fixed. This species, he further observes, does not, therefore, appear, like the larva of *A. sylvanus*, to roll up a green leaf into a sort of cocoon in which to pupate. One suspects from the evidence of Mathew, etc., that this is not accurate and that it does do so. The pupal stage lasted from June 18th to July 8th. Snellen notes the pupal period as lasting 13 days, from July 15th to the 28th.

Pupa.—The pupa was very remarkable, as might be expected of a Hesperiid. [It is figured, front and back, in figs. 4-5, and an enlarged figure of the head is given in fig. 6.] On the ventral side, the pupa was yellow-green, on the dorsum darker green with four yellow longitudinal lines not extending the whole length, the wing-covers and the tail were yellow. On the green head stood a pin-shaped, slightly forward bent little horn, which, on its red extremity was beset with little black-red hooked bristles. The proboscis-sheath, which is basally, naturally fixed in the covering of the pectus and feet, was beyond the end of the wing coverings free, but unbent and stuck out beyond the half of the abdomen. The three last segments retreated to the extremity in a solid cone. Round the stigmata on the abdominal segments are some brown spots. At the tail end no hooks were to be found. Circumstances are here reversed, for, in the pupæ of most moths, it is by the tail end that the pupa is fixed to the spinning. The hooklets or crotchets that one there finds on the anal extremity one here observes on the nose-horn. When the pupa-skin ruptures in that case for the emergence of the imago, the suture at the back of the head splits and the head-cover remains united with the proboscis-sheath. Here, on the contrary, the suture splits across the forehead and the headpiece

remains fixed to the silk. I mention this substantial difference, because I have not yet seen it satisfactorily described by any author. (I expected the imago to emerge some time in July, but having to leave it for a time, on the 8th found the imago had emerged.) Snellen van Vollenhoven, *Sepp's Nederlandsche Insecten*, 2nd series, iii., p. 86. Long, yellowish-green in colour, retaining the dark dorsal stripe seen in the larva. About four days before the perfect insect emerges the wings assume their golden-brown colour, and the eyes become a brilliant crimson, changing in two days to black, and the black-tipped antennæ are then plainly visible through the pupa-case (Hawes).

Time of appearance.—The species is single-brooded, although its time of appearance is sometimes spread over a considerable period. In its more southern and eastern lowland localities on the Continent it is well out in June and July; as early as May in the Sierra de Ronda; May and June at Lambessa; June at Nice and La Turbie; in the mountains it appears about the middle of July and continues till mid-August, whilst, in Britain, it may appear before the end of June and may continue until the middle of August, depending upon the season. The following actual dates of capture will illustrate this. Captures made abroad, *e.g.*:—June 21st, 1871, three specimens captured in Jersey (Luff); June 30th, 1880, between Coimbra and São Antonio, and June 24th, near Villa Real (Eaton); July 19th-23rd, 1890, at Tancarville (Leech); July 28th-August 8th, 1894, at Courmayeur; July 26th-31st, 1895, at Mendel Pass; July 30th-August 5th, 1896, at Le Lautaret; August 5th-12th, 1896, at La Grave (Tutt); last week in June, 1897, between Sépey and Aigle (Wheeler); July 5th, 1897, at Villach; July 8th, 1897, at Lamsdorf; July 16th, 1897, at Wolfsberg (Chapman); late July and early August, 1897, very abundant but worn at St. Michel-de-Maurienne; end of July and beginning of August, 1898, at Pré St. Didier (Tutt); June, 1899, at Susa (Rowland-Brown); July 27th-August 6th, 1899, at Simplon; August 12th, 1899, at Evolène (Tutt); July 1st-12th, 1899, at Fusio; July 22nd-31st, 1900, at Guarda; July 16th-20th, 1900, at Macugnaga (Chapman); June 5th-6th, 1900, on Mount Hermon (Nicholl); July 3rd-9th, 1900, at Buda-Pest (Lang); July 29th-August 6th, 1900, at Larche; August 7th-8th, 1900, at Barcelonette; August 9th-16th, 1900, in the Guil Valley—Abriès, &c.: August 18th-24th, 1900, worn, at Grésy-sur-Aix (Tutt); July 13th, 1901, at Fusio (Fison); July 18th-20th, 1901, at Tragacete (Chapman); June and July, 1901, in the Alpes-Maritimes (Powell); July 5th, 1902, at Brigue (Sheldon); July 17th, 1902, at Gondo (Fison); August 17th, 1902, near the Chapeau, Chamonix (Tutt); July 24th, 1903, in the Ganter Thal (Wheeler); July 26th, 1903, at Simplon (Sheldon); July 29th, 1903, worn, in the Combe d'Arolla (Tutt); July 2nd, 1904, above Grindelwald (Lowe); July 23rd, 1904, at Basle; July 28th, 1904, on the Grand Salève; in the Saas-Thal—Hüteck, Balen, Almagell, Saas-Grund to Saas-Fée, Saas-Grund to Mattmark, August 6th-12th, 1904; August 3rd-5th, 1905, at Bourg St. Maurice; August 9th-13th, 1905, at Pré St. Didier, Courmayeur, and the Val Véni; August 14th-16th, 1905, between Val Tournanche and Breuil (Tutt), etc. In Britain, dates recorded are as follows:—June 30th and July 11th, 1889, at Shoeburyness; July 7th, 1889, at Leigh; July 15th-

27th, 1890, at Shoeburyness; July 14th-17th, 1891, at Benfleet (Whittle); August 4th, 1890, at Burwell Fen (Farren); July 10th-16th, 1892, at Benfleet (Whittle); July 16th, 1892, on the sea-wall at Leigh (James); July 24th-26th, 1892, in the Dovercourt district (Mathew); July 10th-August 4th, 1894, at Benfleet (Whittle); July 19th, 1894, at Benfleet (James); July 6th, 1895, at Southend; July 7th, 1895, at Leigh; July 8th, 1895, between Barking and Shoebury; July 10th, 1895, at Canvey; June 28th and July 3rd, 1896, unusually common, at Canvey; July 1st, 1896, bred from larva taken at Canvey, on June 9th (Whittle); July 13th, 1896, abundant on Cliffe Marshes, under Cliffe Fort (Bower); imagines abundant, end of June, 1897, at Canvey; July 5th and 7th, 1897, at Westcliff (Whittle); July 13th, 1897, in boundless profusion at Hadleigh Castle (James); very plentiful on the sea-wall east of Gravesend, July 17th, 1897 (Battley); July 14th, 1898, at Shoebury; July 23rd, 1898, at Great Wakering; July 27th-30th, 1898, near Hadleigh; August 2nd, 1898, at Pitsea (Whittle); July 25th, 1898, near Bedford (Hatton); common, August 1st, 1898, at Leigh (Hall); August, 1898, at Mucking (Burrows); June 30th, 1899, at Shoeburyness; July 12th, 1899, at Eastwood; July 14th-21st, 1899, at Benfleet (Whittle); first seen in 1899 at Woodham Mortimer on July 14th (Raynor); first week of August, 1899, common, at Burwell Fen (Butterfield); July 3rd-9th, 1900, at Benfleet; one emerged July 19th, 1900, from pupa found at Benfleet (Whittle); July 25th, 1900, at Tilbury (Image); July 6th, 1901, at Westcliff (Whittle): July 18th, 1902, at Tilbury (Image); July 30th, 1902, at Thundersley; August 5th, 1902, at Coombe Wood, Essex; July 21st-24th, 1903, at Benfleet (Whittle); first seen at Hazeleigh on July 17th, 1903; July 16th, 1904, at Danbury; July 11th, 1905, at Hazeleigh (Raynor); July 15th, 1904, at North Fambridge; July 18th-23rd, 1904, at North Shoebury; July 19th-26th, 1904, at Childerditch (Whittle); July 27th-28th, 1905, at Ashton Wold, Oundle; August 9th, 1905, at Burwell Fen (Rothschild).

Habitat.—The habitats of *A. lineola* are extremely varied. In Britain, almost confined to the grassy slopes of the sea-wall and a short distance inland therefrom in our southeastern counties, in addition to a few boggy inland places, we find it, on the continent, equally abundant in the long grass by hedgesides, in clover and lucerne fields, on flowery slopes in the alpine valleys, on the slopes of high alpine paths, on grassy uplands and even on high flowery pastures from 5000 ft. to 7000 ft. elevation, *e.g.*, in the Val Véni, at Simplon, Le Lautaret, Abriès, etc. On the flowery slopes between Bourg St. Maurice and Bonneval-Bains, it haunted the same ground as *A. flava* (*thaumas*) and *T. acteon*, whilst at the roadway puddles in this district it was particularly abundant, so also it was at the water-runnels crossing the roads at Abriès in 1900, where it consorted with the blues. In long grass, at the end of July, 1899, by the side of the meadows at the village of Simplon, it was extremely abundant, and at Megève, in long grass by the side of a footpath crossing the upland meadows, it was in millions, whilst by the roadside between Megève and Combloux it was in great numbers on almost every thistle flower; but it also loves the lowlands, and Leech found it abundant in a limestone quarry at Tancarville, some 200 or 300 yards from the Seine. In Britain it is recorded as abundant on the saltmarshes at Leigh,

Essex, where it is not mixed with *A. flava* (*thaumas*), but as one ascends the hills towards Hadleigh, the latter species becomes common and the former comparatively rare (Tugwell). James corroborates this statement, except that he found *A. lineola* in the greatest profusion with *A. flava* (*thaumas*) round Hadleigh Castle in July, 1897, although, as in the former case, all the specimens obtained on the seawall were *A. lineola*. In Kent, the Thames marshes between Gravesend and Cliffe, and the Medway marshes below Strood, where the insect is also abundant, are not unlike the Essex haunts. It is not, however, in Essex confined to the sea-coast, for Spiller records it as abundant in Essex in 1885 and 1887 in clover fields, also settling on flowers in cornfields and occasionally occurring in grassy lanes (*Ent.*, xxiii., p. 56), whilst Whittle found it commonly in a field some three miles from the river-marshes near Southend, where it is abundant; Raynor states that the imagines, in great numbers, settle on the flowers of lucerne, which *A. flava* also frequents, at Hazeleigh, etc., and Whittle observes that, although, in the Southend district, the species some fifteen years ago appeared to be confined to the seawall and adjacent marshes, it now goes far inland, *e.g.*, a rough field outside Carpenter's Wood at Hadleigh, July 12th, 1899, on Thundersley Common, July 30th, 1902, by the roadside at North Fambridge, July 15th, 1904, also on the roadside at Childerditch, a good many miles from the river, and near Lower Warley, July 19th, 1904; at Mucking it prefers the hillsides. Nash reports it in woods and lanes near Bedford, whilst on Burwell Fen, in rough sedgy places, the species is not at all uncommon. Lowe notes it as most abundant in the meadows above Grindelwald, and Wheeler in the meadows and roads of the Valais up to more than 5000 ft. and it appears to reach a considerable elevation in its mountain haunts. Mrs. Nicholl reports it at 3000ft.-5000ft. on Mount Hermon, and Swinton on the top of the Mount of Olives, near Jerusalem, whilst we ourselves have found it in abundance not only in all the clearings of the larch forest above Abriès, but right up on the slopes of the Crête de la Reychasse, at almost 7000ft. elevation, and, on flowery banks at Le Lautaret, in the Dauphiny Alps, it reaches an almost equal elevation; we have found it high up on the moraines of the Meije glacier (as well as on the roadside a mile below La Grave), on the slopes above the Chapeau, on the moraines of the Mer de Glace; it abounds also in the flowery openings of the woods of Mont de la Saxe, as also on the dry flowery hill-slopes at Mendel Pass and Cortina; at Mendel, indeed, it was, with *Urbicola comma*, exceedingly abundant, careering over the flower-clad slopes of the mountains everywhere. In Tuscany it abounds locally, but always in dry places.

Habits.—The imagines of *A. lineola*, like those of its neighbours, rest with their wings held vertically over the back, but, when sunning, they settle with their backs to the sun, letting down at once all their wings till the forewings make an angle of about 45° from the vertical plane of the back. They then lower the hindwings till quite horizontal, there being quite an angle of 45° between the upperside of the hindwing and the underside of the forewing. They have also a habit of flying rapidly among the long grass, on which their larvæ live, without coming often above the grass tops. At other times they flit swiftly from flower to flower on sloping flowery banks, whilst, yet again, they will settle down, with their wings over their back on a thistle or *Centaurea* flower,

and suck the honey greedily. At Mendel Pass the species was in amazing profusion at the end of July, 1895, on thistle flowers, whilst at Digne it is equally abundant at the end of June on flowers of lavender. Even in the Essex and Kent marshes they prefer the flowers, and Bower notes them as abundant under Cliffe Fort, in July, 1896, quarrelling for a place at the flowers growing there. In our experience this is, next to *Urbicola comma* and *Hesperia alveus*, the most abundant of all the skippers at the runnels of water on the mountain-paths of the central Alps of Europe, remaining sucking at the fluid for a very long time in the hot sun unless disturbed. At the end of the afternoon the imagines settle down to rest, their wings raised in true butterfly fashion over their backs, on the flowers and grass among which they have been flying during the day. James says that the imagines are to be found commonly at rest on the grass growing on the seawall of the Essex coast at the end of the afternoon. It appears to vary in its abundance, in some years in its Piedmont and Tuscan localities, as well as in Switzerland and southern France, it is in amazing numbers even where it is nearly always abundant.

British localities.—Bedford: Near Bedford (Hatton). Cambridge: Burwell Fen (Tutt), Wicken Fen (Rothschild). Essex: Common along the coast but apparently not far inland—Leigh (Smith), Tilbury (Image), Mucking (Burrows), Southend, Benfleet, Canvey, Westcliff, Hadleigh, Eastwood, Wakering, Thundersley, North Fambridge, Shoeburyness, Childerditch (Whittle), Dovercourt district, Harwich (Mathew), Brightlingsea (Carrington), Danbury, Hazeleigh, Northey Island, Woodham Mortimer (Raynor), Felstead (Mackmurdo), St. Osyth (Barrett). Hunts: Fen districts (Oldham), Monks Wood, Abbots Ripton (Rothschild). Kent: Sheerness, near Strood (Walker), Cliffe Marshes (Bower), near Gravesend (Battley). Northampton: Ashton Wold, Oundle (Rothschild). Notts: Clumber (Young *teste* Barrett). [Somerset: Taunton (Bidgood).] Suffolk: Rare, probablyover looked—Bures, near Sudbury (Gerrard), Chappel (Barrett). Sussex (Barker).

Distribution.—Throughout the whole Palæarctic area except the Polar region and the Canary Isles (Staudinger). Africa: Algeria—Lambessa (Oberthür), Tunis (Rühl). Asia: Asia Minor, throughout (Rebel), Mount Hermon, Antilebanon (Nicholl), nr. Jerusalem (Swinton), Amasia, Tokat, Taurus, Derbent, Achal-Tekke dist.—Kopet-Dagh, Schahkuh, Lenkoran, Astrahabad, Saisan, Ema, Ussuri, Sutschan, Baranowka, Nicolaiefsk, Thian-Shan, to 7000ft. (Rühl), Amurland (Elwes). Austro-Hungary: Hungary—Buda-Pest, etc. (Nicholson), Tyrol dist.—Mendel, Cortina, etc. (Tutt), Pfous (Galvagni), Brenner (Rowland-Brown), Glockner dist. (Rühl), Dalmatia—Zara (de la Garde), Heiligenblut (Rühl), Villach, Lamsdorf, Wolfsberg (Chapman), Karlsbad, Brünn, Salzburg, Fünfkirchen, Hermannstadt, Lipnik, etc. (Rühl). Belgium: Colonstère (Donckier), St. Gervais (Castin), Bas Prés de Salzinnes (Pirsoul), Bouge, Fond d'Arquet (Lambillion), Dinant (Lenoir). Bosnia and Hercegovina: Dervent (Hilf), Jaice (Apfelbeck), Fojnica (Simonys), Visegrad (Sturany), Sarajevo, Trebevic (Rebel), Cvrstnica, Vran Planina (Hilf), Nevesinje (Uhl), Prenj—Tissovica (Rebel), Glovogo to 1300 m. (Penther), Vucija-Bara (Hilf). Bulgaria and East Roumelia: Sophia (Bachmetjew), Rilo (Elwes), Rasgrad (Markowitsch), Varna, Slivno, common (Rebel). Channel Islands: Jersey (Luff). Denmark: Rare (Aurivillius)—Fyen, Jutland, North Zealand (Bang-Haas). Finland: Rare (Aurivillius). France: Throughout in suitable places (Tutt). Nord dept., common (Paux), Normandy—Tancarville (Leech), Rennes dist., Cancale (Oberthür), Vannes, Stoërmel, Monterfil (Griffith), Calvados (Montiers), nr. Châteaudun, Lardy, Fontainebleau (Berce), Indre—Brenne (Martin), Nohant, St. Florent. Auvergne, Murat, Le Livran (Sand), Aube—Les Riceys, Ervy (Jourdheuille), Allier—Moulins (Peyerimhoff). Sâone-et-Loire (Constant), Loire-Inférieure (Bonjour), Aude (Mabille), Gironde (Brown), Haute-Garonne (Caradja), Savoy Alps—Grésy-sur;Aix, Megève, Chamonix, Bourg St. Maurice, Basses-Alpes—Barcelonette, Larche. Digne, Hautes-Alpes—the Guil Valley, Abriès, Dauphiny Alps—Le Lautaret, La Grave, St. Michel de Maurienne, etc. (Tutt), Isère—Uriàge.

Hautes-Pyrénées—Cauterets (Oberthür), Le Vernet (Rowland-Brown), Alpes-Maritimes to 2000 m.—Nice, Turbie, etc. (Oberthür), St. Martin Vésubie (Rowland-Brown), Cannes (Methèri), Ste. Maxime, Entrevaux, Avenos at 1000m. (Powell). GERMANY: Throughout—Baden, Alsace, Pfalz, Württemberg, Nassau (Reutti), Bremen, Hilden, Elberfeld, Sachsenwald, Eutin, Mecklenburg—Moritz, Pomerania, Frankfort-on-Oder, Brieg, Silesia—Glogau, Dresden, Chemnitz, Leipzig, Dessau, Wernigerode, Thuringia, Cassel, Wiesbaden, Kempten, Constance (Rühl). GREECE: Parnassus (Rühl). ITALY: Throughout Tuscany very abundant—Livorno, etc. (Stefanelli), Piedmont, Val Anzasca, Macugnaga, Val Tournanche, Pré St. Didier, Courmayeur, Val Véni (Tutt), Apennines—San Marcello Pistoiese (Verity), near Boscolungo, Certosa di Pesio (Norris), Susa (Rowland-Brown), Lombardy, Abruzzi, Naples (Zeller), Sicily—Syracuse (Bellier), Osimo (Spada), Castelbuono, S. Martino (Struve). NETHERLANDS: Rare (Snellen), Buda (Rühl). PORTUGAL: Between Coimbra and Sao Antonio, Villa Real (Eaton). ROUMANIA: Dulcesti (Hormuzaki), Comanesti, Tultscha (Caradja). RUSSIA: Baltic Provinces—Livonia, Kurland, etc., common (Nolcken), St. Petersburg, Moscow, Kaluga, Smolensk, Gorki, Kasan, Orenburg, Novorossiisk on the Black Sea, Caucasus (Rühl). SCANDINAVIA: southern Sweden—Skania, Blekinge, Södermanland. NORWAY: south Norway, extreme south Finland, Nyland, Karelia (Lampa), Rosersberg (Rühl); the most northerly locality is Upland (Aurivillius) SERVIA: Nisch, Ak-Palanka (Hilf). SPAIN: Aragon, Castile, Tragacete (Chapman), Grenada (Rambur), Malaga (Rühl), Andalusia—Sierra de Ronda (Oberthür), Gibraltar (Parry). SWITZERLAND: Rare and local in the lowlands, *e.g.*, Berne, Liestal, Basle, St. Gall, distributed and generally common in the mountains to 5000ft., *e.g.*, Jura, Valais, Grisons, etc. (Frey), Geneva—Grand Salève (Tutt), Bergün (Rühl), Weissenberg (Huguenin), Gondo (Fison), Simplon (Tutt), Pontresina Bad Alveneu, Disentis (Lemann), Thusis (Fountaine), Brusio (Fison), Guarda, Fusio (Chapman), Zermatt Thal—Randa (Harcourt-Bath), Brigue, Ganter Thal (Wheeler), Saas-Thal—Stalden, Hüteck, Saas-Grund, Almagell, etc., Combe d'Arolla, Haudères, Satarme, Villar, Evolène, etc. (Tutt), between Sépey and Aigle (Wheeler), Grindelwald (Lowe), Bevers Valley (Nicholson).

## ADOPÆA FLAVA, Brünnich.

SYNONYMY.—Species: **Flava,** Brünn., "Pontoppidan's Danske Atlas," i., p. 685 (1763); Prout, "Trans. City Lond. Ent. Soc.," p. 53 (1898); "Ent. Rec.," xiii., p. 346 (1901). **Comma,** Barbut, "Linn. Gen. Ins.," p. 173, in part, desc. (1781). **Thaumas,** Hüfn., "Berl. Mag.," ii., p. 62 (1766); Rott., "Nat.," vi., p. 4 (1775); Esp., "Die Schmett.," i., pl. xxxvi. (supp. xii.), figs. 2, 3 (1777); p. 344 (1779); xcviii. (cont. lii.), figs. 5-10 (1785); Schneid., "Sys. Beschr. Eur. Schmett.," p. 273 (1785); Bork., "Sys. Besch.," i., pp. 181, 285; ii., p. 236 (1788); "Scriba, "Journal," iii., pp. 244-7 (1791); Lewin, "Insects," &c., p. 94, pl. xlv., figs. 5-7 (1795); Led., "Verh. zool.-bot. Gesel.," ii., p. 26 (1852); Hein., "Schmett. Deutsch.," p. 117 (1859); Staud., "Cat.," 1st ed., p. 15 (1861); Kirby, "Eur. Butts.," p. 22 (1862); Snell., "De Vlinders," p. 87 (1867); Nolck., "Lep. Fn. Estl.," p. 83 (1868); Kirby, "Syn. Cat.," 609, 829 (1871); Staud., "Cat.," 2nd ed., p. 35 (1871); Mill., "Cat. Lep. Alp.-Mar.," p. 116 (1872); Curò, "Bull. Soc. Ent. Ital.," p. 216 (1874); Kirby, "Eur. Butts.," p. 66 (1879); Lang, "Butts. Eur.," p. 350, pl. lxxxi., fig. 9 (1884); Kane, "Eur. Butts.," p. 146 (1885); Auriv., "Nord. Fjär.," p. 39, pl. vii., fig. 14 (1889); Watson, "Proc. Zool. Soc. Lond.," p. 98 (1893); Rühl, "Pal. Gross-Schmett.," pp. 638, 828 (1895); Meyrick, "Handbook," etc., p. 358 (1895); Tutt, "Brit. Butts.," p. 139 (1896); Kirby, "Handbook," iii., p. 20 (1897); Staud., "Cat.," 3rd ed., p. 92 (1901); Lamb., "Pap. Belg.," p. 270 (1902). **Linea,** Müll., "Mel. Soc. Turin," iii., p. 192 (1766); Schiff., "Schmett. Wien.," p. 160 (1775); Bergstr., "Nomencl.," pl. xc., figs. 5-8, p. 38 (1780); Fab., "Mant.," ii., p. 84 (1787); "Ent. Sys.," iii., p. 336 (1793); Hb., "Eur. Schmett.," pl. xcvi., figs. 485-486 ♂, 487 ♀ (1802); text p. 72 (*circ.* 1805); "Larv. Lep.," i., Pap. II., Gens Ec, fig. 2a (*circ.* 1800); Schrank, "Fauna Boica," ii., pt. i., p. 159 (1801); Ill., "Schmett. Wien.," 2nd ed., ii., p. 146 (1801); Haw., "Lep. Brit.," p. 51 (1803); Ochs., "Die Schmett.," i., pt. 2, p. 228 (1808); Latr., "Consid. Gen.," p. 208 (1810); Leach, "Edin. Encycl.," ix., p. 130 (1815); Oken, "Lehrb. Zool.," iii., pt. 1, p. 759 (1815); Ochs., "Die Schmett.," iv., p. 34 (1816); Dalm., "Vet. Ak. Handl.," xxxvii., p. 200 (1816); Hb., "Verz.," p. 113 (1816); Latr., "Enc. Méth.," p. 770 (1819); Sam., "Ent. Comp.," p. 242 (1819); Godt., "Hist. Nat.," i., p. 233, pl. xii., fig. 3., pl. xii tert., fig. 2 (1821); Bdv., "Eur. Lep. Ind.," p. 27 (1829); Stphs., "Sys. Cat.," pt. 2, p. 27 (1829); Meig., "Eur. Schmett.," p. 69, pl. lvi., figs. 4 *a-d* (1830); Bdv.,

"Icon. Chen.," pl. i., figs. 5-6 (1832); Treits., "Die Schmett.," supp., x., i., pp. 97, 248 (1834); Stphs., "Ill.," iv., p. 405 (1834); Curtis, "List," 2nd ed., p. 306 (1837); Wood, "Ind. Ent.," p. 9, fig. 78 (1839); Bdv., "Gen. et Ind. Meth.," p. 35 (1840); Dup., "Cat. Meth.," p. 35 (1840); "Icon. Chen.," p. 212, pl. xxxi., fig. 89 (1849); Bdv., "Gen. et Ind. Meth.," p. 35 (1840); Humph. & Westd., "Brit. Butts.," p. 129, pl. xli., figs. 8-12 (1841); Evers., "Faun. Volg.-Ural.," p. 87 (1844); H.-Sch., "Sys. Bearb.," p. 159 (1846); Stphs., "List," 1st ed., p. 22 (1850); Dbldy., "Syn. List," p. 2 (1850); Westd. & Hewits., "Gen. Diurn. Lep.," p. 522 (1852); Wallgrn., "Skand. Dagf.," p. 258 (1853); Stphs., "List," 2nd ed., p. 21 (1856); Sta., "Man.," i., p. 68 (1857); Speyer, "Geog. Verb.," p. 288 (1858); Ramb., "Cat. Lep. And.," p. 87 (1858); Freyer, "Neu. Beit. Schmett.," vii., p. 55, pl. 631, fig. 1 (1858); Newm., "Brit. Butts.," p. 179 (1869); Butl., "Cat. Diurn. Lep.," p. 277 (1869); Buckler, "Larvæ," etc., i., pp. 139, 195, pl. xvii., fig. 3 (1886); Dale, "Brit. Butts.," p. 215 (1890); Barr., "Lep. Brit. Isles," p. 275, pl. xxxviii., figs. 1-1*e* (1893). **Flavus,** Müll., "Zool. Dan. Prod.," p. 115 (1776); Wheeler, "Butts. Switz.," p. 11 (1903). **Divaricatus,** Geoff., "Fourc. Ent. Par.," p. 246 (1785). **Venula,** Hb., "Eur. Schmett.," pl. cxxx., figs. 666-669 ♀ (post. 1808).

Original description.—Herr Brunnich thus describes *flava*, a species not hitherto known: "*P.P.* alis integerrimis flavis limbo nigro albo terminato, supra infraque concoloribus. See tab. xxx" (Pontoppidan). [The figure here cited is a typical ♀ of this species, recognisable at a glance (Prout).]

Imago.—Expanse 27mm.-31mm. All four wings orange-fulvous or fulvous-brown, unspotted, costa and outer margin blackish; nervures finely black towards outer edge; fringes pale; ♂ with oblique androconial mark on forewings. The antennæ reddish-ochreous at tip. The underside of forewings centrally fulvous, apex grey-green, a black shade at base of inner margin; of hindwings greenish-grey to orange-ochreous, a bright orange-fulvous patch at anal angle.

Sexual dimorphism.—Very marked in that the ♂ has a very distinct linear, somewhat long, basally curved, black androconial streak, placed obliquely beneath the discal cell, and turned down towards inner margin at base, the ♀ being of course unmarked. The ♀ is usually rather larger, and heavier-looking than the ♂, whilst the colour is almost the same in both sexes. "The androconial scales are in general completely jointed, and of the unjointed scales which are found among them there are comparatively few, and of these their flattened extremities are more elongated than those of the fan-shaped scales of *Augiades sylvanus*. "Covering-scales" are wanting, the normal scales next to the 'fleck' (discal streak) are somewhat longer and larger than the rest. The tuft of hairs is wanting on the hind legs" (Aurivillius).

Gynandromorphism.—We can only trace the two following gynandromorphic examples of this species:—

*a*. Right side ♂, left side ♀. The genitalia are abnormal, being ♂ of full size, but with much flattening and distortion of the apical lobe of tegumen, and with a large supplementary chitinous lobe (which appears to spring from nearly the same point as the clasp) present on the left side (Edwards, *Ent.*, xxxi., p. 31, fig.).

*β*. A ♂, taken July 22nd, 1900, at Ashton Wold, Oundle, which entirely lacks the androconial streak (Rothschild, *Ent. Rec.*, xvii., p. 108).

Variation.—There appears to be very little variation in this species, either in size or colour, in the British Islands. A few fall 1mm. or 2mm. below, and others above, normal size, whilst one also notices a little difference in the intensity of the ground-colour, some specimens being rather more orange-fulvous, others a shade darker or

brownish-fulvous. A very extreme pale aberration occasionally occurs = ab. *pallida*, n. ab. This pale form is somewhat bone-coloured, *i.e.*, whitish tinged with yellow. It was first described and figured by Ernst and Engramelle (*Pap. d'Europe*, ii., p. 285, pl. 74, figs. 95*a-b*), in 1780, from a specimen in Gerning's collection. McArthur records an example of a straw-coloured tint, and much paler towards the base, taken in the Brighton district, in 1900 (*Proc. Sth. Lond. Ent. Soc.*, 1900, p. 92), and Talbot a somewhat similar bone-coloured aberration as occurring occasionally at Wakefield (Porritt's *List of Yorkshire Lepidoptera*, p. 16). The form occurs in both sexes, the ♂ being figured in Mosley's *Illustrations*. Rowland-Brown has an aberration of this species taken in August, 1898, at Zinal, in the Val d'Anniviers, in which the whole of the fore- and hindwings on the upper- and undersurface, has a silvery-white appearance (not unlike *Chrysophanus* ab. *schmidtii*), possibly the results of some failure of pigment. Hill describes (*Ent. Rec.*, xiii., p. 359) a curious aberration, taken at Folkestone in June, 1901, the anterior wings of a silvery bone-colour, the posterior wings shot with iridescent green = *pallida-virescens*, n. ab. Fowler records (*Entom.*, xxvi., p. 32) the capture, almost every year at Ringwood, among rushes, of a form (=ab. *suffusa-virescens*, n. ab.), occurring in both sexes, in which the forewings, from the base to the anal angle, right round to some distance into the costa, is broadly suffused with dark greenish; the hindwings of this form being quite as dark as those of *Thymelicus acteon*, the small proportion of tawny showing up vividly, and the typical form being very light in comparison. The underside is greenish. Oberthür notes (in *litt.*) a ♀ aberration of a dark brown colour from the Bois de Boulogne, we suspect, from the description, a parallel form with our *A. lineola* ab. *suffusa*, which might also be called ab. *suffusa*, n. ab. He has, however, a much more remarkable aberration, in which the blackish parts of the wings and the body are of a yellowish blond, paler than the normal ground colour, the discal streak of the forewings being silvery-grey, the antennæ red (rubro-rufus) = ab. *reversa*, n. ab. Oberthür further observes that the Syrian examples are markedly paler than the European type form = var. *syriaca*, n. var., whilst Rühl notes that, in many examples from Asia Minor, the underside of the hindwings and apex of forewings are bright yellow in tint. Those of the Hautes-Pyrénées are rather darker than the usual form, the ground colour of the hindwings being particularly suffused, the form occurring as an aberration in other localities = ab. *obscura*, n. ab. Spain and southern France produce a very bright, and rather small, form, from 28mm.-30mm., with very bright golden-brown ground colour, and narrow, clear-cut, black marginal edge, the ♀ with no trace of lunule at end of discoidal cell = ab. *iberica*, n. ab., from Canales, Moncayo, Bejar, Piedrahita, and Tragacete in Spain, and Larche in the Basses-Alpes. Except for the much brighter colour, this is not very unlike that of the plain district further north—Fontainebleau, etc. Lemann records a large form from Villach, and we have examples from Guarda, Fusio, Torre Pellice, Bourg St. Maurice, etc., in which the average wing expanse is from 33mm.-36mm., the ♀ with a more or less marked dark discal lunule at the end of the cell = var. (*et* ab.) *major*, n. ab., a more suffused dark margin and well-developed dark

nervures appear also to go with the large form. We suspect the species varies much more than is generally supposed.

Egglaying.—Eggs laid in a row in a folded grass blade about July 29th, 1865, the larvæ appeared on August 12th (Hellins). Hawes asserts (*Ent.*, xxv., p. 177) that the eggs do not hatch until the following spring.

Ovum.—The egg has all the appearance of a flat egg, having three axes of different lengths; in reality, it is an upright egg of this peculiar form, the micropylar axis being perpendicular to the surface on which the egg is laid, *i.e.*, the micropyle is on the top of the egg. It is of a pale yellow colour (in an egg dissected from a ♀), the base and top rather flattened, with the edges smoothly rounded and rather rimmed around the upper surface. The surface has a granulated appearance and there is a faint, irregular, cellular surface reticulation. The micropyle is placed in a slight central depression of the upper surface, has, in the eggs examined, 7 canals (?), surrounded by a rosette of 10 rather pointed cells, the latter being again surrounded by numerous larger elongated cells with rounded ends. The measurements are:—height (=micropylar axis) 0·4mm., length 0·9mm., width 0·7mm., the micropylar area being about 0·1mm. in diameter. In superficial appearance the outline of the egg bears some resemblance to that of a miniature egg of *Amorpha populi*. [Sich. Described, July 22nd, 1905, from a fully-developed egg dissected from the body of a ♀.] Not at all like that of *Augiades sylvanus*, being considerably smaller, of a long oval figure, half as long again as wide, the shell glistening, devoid of ribs or reticulation; at first white, then turning dull yellowish, and at last paler again with the dark head of the larva showing through (Hellins).

Habits of larva.—The larvæ leave the egg in August (12th, 1865 and 15th, 1876, *teste* Hellins), and feed very little before hybernation, spinning almost as soon as hatched little ropes of silk across the blades of grass, and making little web coverings for themselves. A larva kept until the middle of November was only about 2mm. in length. Freyer, however, says (*Neu. Beit.*) that the larvæ are of good size in August and September in woods where there are brambles and tall grass, that it hybernates, and is fullgrown in May. [This remark only shows the necessity of working out the lifehistory *ab ovo*.] After hybernation, and when nearly fullgrown in early June, they may be swept in the evening from *Holcus lanatus*, a very soft pubescent grass, with which they assimilate both in colour and texture remarkably well. They continue to feed on this grass, *Brachypodium sylvaticum*, etc., till towards the end of June, their movements being very sluggish, and, after eating a considerable quantity of food, they enclose themselves within spun-together leaves of grass for pupation. Larvæ are noted as having been found in nature as follows:—July 17th, 1869, fullfed larva at Painswick Hill (Watkins); one found on grass in a chalk-pit on South Downs near Steyning, June 29th, 1903, which spun up first week in July, and imago emerged July 19th (Bird); larvæ as late as August 27th, 1902, at Burgess Hill, a very late season (Dollman).

Larva.—*Final instar:* The full grown larva is 21mm. in length its general figure of moderate substance, stoutest in the middle of the body, tapering a little from the thoracic segments towards the head,

which is globular and projecting, larger than the prothorax, which is remarkably small and short; the last four or five segments also taper gradually when seen from above, and when viewed sideways the back appears slightly arched, and sloping gradually to the anal flap, which is a trifle flattened and rounded off behind; the belly is flat and the legs are all well beneath it and rather short; the segmental divisions are very delicately defined, also most particularly the subdividing transverse wrinkles, which by no means arrest attention, but have to be diligently sought. Head of a rather deeper green than the body, rough with minute points, the upper lip of a pinkish hue, is smoother and deeply channelled, the ocelli black; the body above is of a tender and delicate light green ground colour, without any gloss, and, on the thoracic segments, the skin is besprinkled with black points of extreme fineness, so that they do not affect the delicate colouring of the green ground; the dorsal stripe is of darker green, rather bluish, very narrow on the prothorax and thence uniformly wider until becoming very gradually thinned off on the anal flap; through the middle of the stripe runs a stoutish line of paler green, and it is bordered outside by a stout line of green still paler than the ground colour; the subdorsal line is of the same pale green, but thinner; at a little distance below, the trachea shows through the skin, and on it can be discerned the rather prominent reddish flesh-coloured spiracles; below these again, at a little distance, follows an inflated paler stripe of almost creamy-whitish, extending round the anal flap, which often hides the belly and legs from view when the larva is in repose, but, at other times, when examined beneath, these are seen to be wholly green, excepting a transverse patch of white on the front of the ventral surface of the 7th and 8th abdominal segments (Buckler). Naked, narrower at each end, the head larger than the neck, of a very green colour with darker green dorsal lines, laterally a whitish-yellow line and just above prolegs a broader yellow line (Scriba *teste* Borkhausen). Very pale-green in tint, with white longitudinal dorsal and lateral lines; a blunt anal point into which the lateral subspiracular lines gradually fade posteriorly (Freyer). Buckler figures (*Larvae*, etc., i., pl. xvii., figs. 3-3*b*) the larva of this species.

Variation of larva.—All the important textbooks refer to Esper's descriptions and figures of four Urbicolid larvæ (*Eur. Schmett.*, i., contin. p. 25, pl. 98 (supp. 12), figs. 5-8) as varieties of this species. The figures are very badly executed, and are more than doubtful as to their species (especially as he says they feed on clover as well as grass). He states that the larvæ agree in form with those of *Pararge egeria*, and are, in their younger stages, difficult to separate therefrom. The dorsum, however, is more rounded, and so are the front segments, but the hindmost segments are narrowed to a wedge, and there are fewer lateral stripes. The head is almost globular and is outstretched from the narrow thoracic segments. [Above the anal claspers are two elongated points which are united and fit exactly together.*] The surface is rough, covered with fine white warts. The ground colour

* One suspects that this cannot belong to an Urbicolid larva, and that Esper was trusting to memory and got mixed. He says that he reared imagines from the three forms of larvæ described, which seems to settle the fact that he had larvæ of this species (*flava*), which, indeed, the presence of the white ventral spots suggests.

uniform green, and, in some varieties, with different admixtures of yellow. Ventrally on the two segments behind tbe last pair of ventral prolegs are four bright white shining spots. In the colour and markings the following varieties have been observed :

1. Bright green in tint ; a rather broad, dark green dorsal stripe, on each side two of finer form edged with yellowish ; the first and last segments of a rather dark green colour ; the fine terminal points have a reddish tint when examined under a lens. On *Alopecurus pratensis*, L. [pl. xcvii. (supp. xii.), fig. 5].

2. Ground colour sea-green, with many very fine alternate dark and light stripes (these markings make it very similar to the larva of *P. egeria*). On *Phleum nodosum*, L. Produced an exactly similar butterfly to 1 [pl. xcvii. (supp. xii.), fig. 7].

3. With a citron-yellow lateral stripe, and very broad dark green stripes. Larva on *Poa rigida*, L. [pl. xcvii. (supp. xii.), fig. 8].

Foodplants.—*Holcus lanatus* (Fletcher), *Brachypodium sylvaticum* (Hellins), *Festuca* (Lambillion), *Aira montana* (Schiffermüller), *Piptatherum multiflorum* (Millière), *Alopecurus pratensis*, L., *Poa eragrostis*, L., *Poa rigida*, L., *Phleum nodosum*, L. (Esper).

Puparium.—The fullfed larva spins together, by means of a coarse reticulation of white silk, two or sometimes three blades of grass, joining longitudinally, by lacing or spinning with white silk, the edges, more or less closely to each other, and thus the larva becomes completely hidden (the earliest spun up on June 18th, the latest about June 25th, 1882). This outside spinning forms, as it were, a lining to the oblong puparium, about 1¼ins. long, in which pupation takes place (Buckler). The larva pupates in June and July within a slight, laced, spinning among the grass, the pupa being suspended at the anal end and by the body by threads (Scriba *teste* Borkhausen). The long and roomy puparium is made of grass blades spun together by means of whitish silk with wide mesh. The larva excretes from the white ventral spots a meal-like matter, which it mixes with the silk of the puparium (Esper). The pupa is about half-an-inch in length and is held in position in the puparium by a silken thread which is placed just under the head, and not round the waist; a larva pupated July 5th, 1869, at Painswick, and the imago appeared on July 17th (Watkins); there is, however, some variation in the length of the pupal stage, Snellen noting it as three weeks, and Borkhausen and Esper as 14 days.

Pupa.—About 17·75mm. in length, very similar in form to that of *Thymelicus acteon*, having the end of the trunk lying free from the abdomen, and held in position, head upward, by an oblique cincture behind the thorax, and the anal tip secured by a fan-like spread of fine hooks at the extremity fixed in the silk lining, but the head has the frontal tapering beak shorter and more bluntly pointed; the colour of the same light green as that of the larva, of which the paler lines can still be faintly traced (Buckler). Two days before emergence, the pupa commences to change colour, beginning at the eyes, and continuing till a darkish slaty shade had spread all over it (Watkins). Of a yellowish-green colour; elongate in form, with narrow head and anal point; from termination of wings, a pale brown, slender, maxillary sheath is continued to the extremity of the body (Scriba *teste* Borkhausen). Of considerable length compared with breadth ; usually yellow in colour, but with some varieties green ; the elongated (but bluntly-pointed) anterior part and the hindmost abdominal segments darker green; also a dark green mediodorsal line. A long maxilla-case, similar to that of

some other Urbicolid pupæ, but found in those of no other butterflies; in this species it extends almost to the anus (figured as reaching the antepenultimate segment), is of uniform thickness, bristle-like, of a bright reddish-yellow colour, lying very close to abdomen, but standing out from the latter when its mobile segments forming the anal end are in movement (Esper). Pale green with a pointed head and a narrow maxillary sheath tinged with rose-red, extending to the anal point (Freyer). The pupa is figured by Buckler (*Larvae*, etc., i., pl. xvii., fig. 3*c*). Esper gives two figures thereof (*Schmett. Eur.*, i., pl. xcviii. [supp. xii.], figs. 9, 10).

Time of appearance.—The species is single-brooded in Britain and possibly throughout its whole range, but, like almost all grassfeeding butterfly larvæ that do most of their feeding in late spring and early summer, the period of emergence is frequently extended, *e.g.*, five or six weeks in a season, normally from mid-June to the end of July. In early seasons, the first imagines appear, however, in early June, and in late seasons not before the middle of July. Abroad, however, the time of appearance varies according to altitude and latitude. The following dates will give some idea of this range of variation. On the Continent—May to the middle of July, in the Baltic States, where it is very rare (Nolcken); at Broussa in May, in June at Taormina (Fountaine); from about May 20th, becoming exceedingly abundant at the beginning of June, at Hyères (Powell); Rowland-Brown notes (*Ent. Record*, xiv., pp. 313-4) the long time over which this supposed single-brooded species emerges, recording it from June 23rd (1899) at Susa, to as late as October 9th (1902) at Beaulieu, one of its most southern European localities; June 29th, 1873, at St. Brelades (Piquet); September 5th, 1882, at Pierrefitte-Nestalas in the Pyrenees (Jones); June 24th-July 13th, 1883, in the woods at Carlsbad (Becher); August, 1888, at Rochefort (Carlier); July 19th-23rd, 1890, at Tancarville (Leech); July 28th-August 8th, 1894, at Courmayeur; June 26th-28th, 1897, at Fontainebleau (Tutt); end of July, 1897, near Sépey (Wheeler); one at Trieste, September 4th, 1897 (Mathew); June 23rd,1899, at Susa (Rowland-Brown); June 26th, 1899, in the Rilska Valley (Nicholl); May 12th-June 16th, 1900, at Orta (Lowe); June 5th, 1900, in the Mount Hermon district (Nicholl); July 22nd-31st, 1900, at Guarda (Chapman); July 28th-August 2nd, at Larche; August 18th-24th, 1900, worn, at Grésy-sur-Aix (Tutt); June 23rd, 1900, on Mont Sény (Witty); July 18th-26th, 1901, at Tragacete (Chapman); July 29th, 1901, at Balsièges (Rowland-Brown); June 20th-25th, 1901, at Botzen (Lowe); abundant but worn, July 30th-August 7th, 1901, at Torre Pellice; August 9th, 1901, at Bobbie (Tutt); July 15th, 1902, at Bérisal; July 12th, 1902, at Aigle (Sheldon); July 29th, 31st, 1902, at Chavoire (Tutt); August 2nd, 1902, at Agincourt; worn, on October 9th, 1902, at Beaulieu (Rowland-Brown); May 25th-June 15th, 1902; May 30th-June 17th, 1903, at Hyères; July 3rd, 1903, at Entrevaux (Powell); July 26th-28th, 1903, at Vésubie (Rowland-Brown); July 27th, at Yvonne; July 28th, 1903, between Useigne and Evoléne (Tutt); May 31st, 1904, at Hyères (Powell); July 1st, 1904, between Fiesch and Brigue (Pearson); July 7th, 1904, at Kahlenburg (Vienna); July 27th, 1904, at Brenner (Rowland-Brown); August 5th-12th, 1904, at Stalden; August 9th, 1904, between Hüteck and Saas-Grund; July 28th-31st, 1905, at

Grésy-sur-Aix; August 3rd-5th, 1905, at Bourg St. Maurice; August 9th-13th, 1905, at Pré St. Didier; August 12th, 1905, in the Val Véni and at Courmayeur (Tutt). The following dates of capture in Britain are exceedingly varied:—August 12th, 1856, at Poynings (Image); August 18th, 1872, at Blean Woods; July 24th-August 17th, 1873, at Wimbledon; July 9th, 1876, at Blean Woods; August 5th, 1877, at Brockenhurst; July 13th, 1884, at Hailsham (Whittle); July 23rd-31st, 1882, in the New Forest (Dobson); September 16th-23rd, 1882, at Folkestone (Hall); July 1st-7th, 1883, at Abbott's Wood (Whinstone); July 18th-August 1st, 1885, at Lymington (Hawes); July, 1884, at Depden, near Bury St. Edmunds (Rowland-Brown); July 4th, 1886, at Reigate; August 1st, 1887, at Swanscombe Park (Whittle); one ♀ taken about 1888, at Stanmore Common, not seen since in that locality (Barraud); July 31st-August 15th, 1889, at Lyndhurst (Hill); July 13th, 1890, at Brockenhurst (Blagg); July 27th, 1890, at Shoeburyness; July 13th, 14th and 17th, 1891, at Benfleet (Whittle); beginning of August, 1891, at Swanage (Alderson); July 16th and 18th, 1892, at Leigh (Whittle); July 22nd, 1892, in the New Forest (Alderson); July 23rd, 1892, at Harrow Weald (Rowland-Brown); June 13th-July 29th, 1892, June 17th-July 3rd, 1893, in Purbeck (Bankes); June 24th-July 10th, 1893, at Morthoe (Sheldon); June 12th, 1893, first appearance for the year at Instow (Hinchliff); June 24th, and again July 22nd, 1893, at Cuxton (Tutt); July 1st, 1893, at Leigh (Turner); July 6th, 1893, at Monk's Wood (Blake); earliest date on which seen in Gloucester, July 3rd, 1894 (Davis); June 25th-July 28th, in Isle of Purbeck (Bankes); July 8th-22nd, 1895, at Leigh (Whittle); July 19th, 1894, at Bournemouth (Bromilow); July, 1894, plentiful in the New Forest (Cox); August 3rd, 1894, on Polegate Downs (James); July 12th, 1896, at Old Hall, Ipswich (Frost); July, 1897, at Cheltenham (Robertson); July 17th, 1898, at Hadleigh; July 23rd, 1898, at Great Wakering (Whittle); July 25th, 1898, near Bedford (Hatton); June 10th-11th, 1899, at Shoreham (Carr); July, 1899, at Bournemouth (Robertson); July 9th, 1897, at Bentley; July 25th, 1898, at Mucking; August 3rd, 1898, at Leigh (Burrows); July 7th, 1899, at Frensham (Bingham-Newland); July 9th, 1899, at Dorking (Carr); July 12th, 1899, at Eastwood (Whittle); July 15th, 1899, just outside Monk's Wood (Rowland-Brown); July 20th, 1899, at Oxshott (Carr); August 1st, 1899, at Swanage (Kemp); July 7th, 1899, July 15th, 1900, at Hazeleigh (Raynor); June 10th, 1900, at Reading (Butler); July 3rd and 9th, 1900, at Benfleet (Whittle); July 15th-August 2nd, 1900, at Newbury (Hopson); July 24th, 1900, in the Gloucester district (Davis); August 11th, 1900, at Folkestone (Pickett); July 10th, 1900, at Benfleet (Burrows); July 11th, 1901, in the Isle of Purbeck (Bankes); July 3rd, 1901, at Hazeleigh (Raynor); June, 1901, at Folkestone (Hills); July 6th, 1901, at Westcliff (Whittle); July 14th, 1901, at Reading (Butler); August 3rd-17th, 1901, at Burgess Hill (Dollman); July 23rd-August 11th, 1902, common in West Sussex (Bird); July 28th, 1902, at Thundersley (Whittle); July 31st-September 4th, 1902, at Burgess Hill (Dollman); five ♂s, August 4th, 1902, at Aldbury Down (Barraud); August 20th, 1902, at Reading (Butler); July 14th, 1902, at Hazeleigh (Raynor); July 11th, 1902, at Mucking; June 30th, 1903, at Tuddenham; July 28th-August 22nd, 1903, at Bentley (Burrows); July 15th, 1903, at Hazeleigh (Raynor); July 11th,

1903, at Reading (Butler); emerged July 11th, 1903, from larva found near Steyning; June 29th, July 21st-August 6th, 1903, in West Sussex (Bird); July 16th, 1903, at Brockenhurst (Lawrence); July 22nd, 1903, at Dorking (Oldaker); July 23rd-August 7th, 1903, worn, at Dawlish (Browne); July 28th, 1903, at Westcliff (Whittle); July 18th, 1903, at Clandon; July 19th, 1903, at Tongwynlais (Shelley); July 25th, 1903, at Oxshott (Pickett); July, 1904, at Tongwynlais (Ansaldo); July 11th-21st, 1904, rather scarce, at Tintern and Llandogo (Bird); July 12th, 1904, at Reading (Butler); July 15th, 1904, at North Fambridge (Whittle); July 24th, 1904, in the Gloucester district (Davis); August 1st, 1904, one ♂ at Aldbury Down (Barraud); July 16th, 1904, at Hazeleigh (Raynor); July 15th-22nd, 1904, at Mucking (Burrows); July 15th-August 7th, 1904; July 20th-August 2nd, 1905, in the Isle of Purbeck (Bankes); July 19th, 1905, at Hazeleigh (Raynor); June 19th, 1905, at Swanage; July 23rd, 1905, at Ashton Wold; July 30th, 1905, at Drayton Beauchamp, very local and almost extinct as the ground becomes more enclosed (Rothschild); July 10th, 1905, at Reading (Butler).

Habitat.—Though generally distributed this species is not found everywhere, being sometimes unaccountably absent in localities where one would expect to meet with it. These, however, are sufficiently varied. In Britain, pastures and fields, meadows, rough grassy places on chalk-hills and downs, bushy places on the outskirts of woods, open ridings in woods, grassy ditch-sides in lanes, especially if flowery banks are near, are among its favourite haunts. It also occurs on boggy ground at Wotton-under-Edge and at Luton, on railway banks at Madeley, and abounds on the slopes and on the salt-marshes near the seashore in many of our eastern counties, swarming with *Adopaea lineola* in Essex and Kent, and abounding on the undercliffs of, and grassy slopes near the sea in, Dorsetshire with *Thymelicus acteon*. Hawes says that it is as common on the marshes near the sea at Lymington as in the enclosures of the New Forest; at Llandudno it frequents the sandhills. It frequents similar places in the plains of Central Europe, and rarely ascends into the mountains to a height of more than about 5000ft., being particularly abundant in the lower valleys of the Alps of Central Europe up to 4000ft., where it chooses flowery banks and slopes, not disdaining the richer fare of lucerne or clover field, often sharing these haunts with *Adopaea lineola*, *Augiades sylvanus*, *Urbicola comma* and *Hesperia alveus*. In France, Duponchel says the species prefers clearings in woods, and of our old British authors, Harris says it flies in woods, Lewin that it is met with on heaths, commons, and in lanes, Donovan that it is most abundant on the outskirts of woods, and Stephens that it frequents the borders of woods and shrubby places.

Habits.—The butterfly skips rapidly from one plant to another in the sun, rarely resting long in one place, and usually choosing a leaf of some bush on which to rest—hazel, dogwood, etc.—darting off rapidly to take up a similar position on another leaf at some little distance, elevating its upper and depressing its lower wings. When at rest, the imagines put their wings right up over the back and remain thus, and do this also when asleep, but when sunning, the hindwings are depressed until they are almost horizontal, whilst the forewings lie back on them in such a manner as to make almost an angle of 45°

with them, the inner margin of the forewing resting along the anal nervure of the hindwing. The imago at this time shifts its body round to such a position that the sun shines fully on its back and wings. Duponchel states that, in France, it is specially partial to the flowers of *Echium*, growing in woodclearings. At Llandogo it chooses *Eupatorium*, whilst on the Cliffe marshes little comes amiss in the way of bloom. In the New Forest it abounds at the flowers in the meadows, whilst in the Alps of Central Europe it is one of the regular habitués at the damp puddles on, or crossing, the roads. The imagines were particularly abundant in early August, 1905, at the runnels by the sides of the road between Bourg St. Maurice and Bonneval-Bains, drinking at the overflow of the irrigation streams or puddles left by the overnight rain. It was seen frequently similarly engaged at the mountain paths, between Pré St. Didier and the Val Véni. It was also abundant on the flowery slopes of the mountains between Bourg St. Maurice and Bonneval-Bains, chasing *Adopaea lineola* and *Thymelicus acteon*, which both occurred on the same flowery banks, and in a flowery meadow at the upper part of the Val Véni on August 12th it was equally abundant but worn, although not so much so as was *A. lineola*, which occurred in the same situations, and had, in both places, the same habit of settling on the flowers, choosing particularly the *Hieracia*. When, however, the insect is on pairing or egglaying intent, it is to be found among the long grass, the female sunning on, or flitting among, the culms comparatively low down, rarely more than a foot above the ground. It is remarkable how variable this species is in Britain in its abundance, in some years quite common, in others very rare. Many observers here noted the fact, *e.g.*, at Guildford, abundant in 1892, rare in 1893, not observed in 1894 (Grover), etc.

British localities.—This species occurs in most of our English and Welsh counties, as well as in the Channel Islands; it is recorded from Ireland by Birchall, but the records are now nearly half a century old, and there are no newer ones. Stainton's Edinburgh record has also never been confirmed :—Bedford : Near Bedford (Hatton), Luton (Vict. Hist. list). Berks : Reading (Butler), Bagley Wood, Boar's Hill, Tubney, Streatley (Geldart), Newbury (Hopson). Bucks : Near Wendover (Brown), Halton, Wavendon near Newport Pagnel (*teste* Stainton), Drayton Beauchamp (Rothschild), Stony Stratford (Foddy). Cambridge : Cambridge (Crisp). Carmarthen : Carmarthen (Jefferys). Carnarvon : Deganwy (Gardner), Llandudno (Harding). Cheshire : local and rare (Day), Eastham (Archer), Delamere Forest, near Oakmere, common (Chappell), near Sutton, Rabymere (Gardner), Alderley (Keyworth), Hooton (Sharp), Malpas (Johnson). Cork : Near Cork (Birchall). Cornwall : Truro (Rollason), Trelawney (Perrycoste). [Cumberland : Carlisle (Armstrong), wants confirmation.] Denbigh : Glyn Ceiriog (Perkins). Devon : Very common at Sidmouth (Majendie), Instow (Hinchliff), Morthoe near Ilfracombe (Sheldon), Dawlish (Brown), Exeter, Plymouth, Teignmouth (*teste* Stainton), Torquay (Crocker), Honiton (Riding), Newton Abbot, Chudleigh (Rogers), Lynmouth (Briggs), Paignton (Goodale). Derby : south of county not uncommon (Brown), Burton-on-Trent (Payne). Dorset : coast and inland abundant, Lulworth (Dale), Swanage (Alderson), Portland (Richardson), Wimborne (Fowler), Blandford, Dorchester (*teste* Stainton), Lulworth Cove (J. W. Douglas), Sherborne (J. Douglas). Durham : One specimen (Harrison). [Edinburgh : Edinburgh (*teste* Stainton).] Essex : general (Harwood), salt-marshes of Essex (Mera), Mucking (Burrows), Hazeleigh, Brentwood, Danbury, Woodham Mortimer (Raynor), Leigh (Turner), Shoeburyness, Southend, Benfleet, Leigh, Hadleigh, Great Wakering, Eastwood, Westcliff, Thundersley, North Fambridge (Whittle), Epping (Stainton). Flint : Overton, Cwm, Rhyl, common Perkins). Glamorgan : Tongwynlais near Cardiff (Shelley). Gloucester :

Cheltenham (Robertson), Aldworth (Todd), Fairford (Taylor), Cirencester, Standish (Nash), Guiting (Green), Prestbury, scarce (Robertson), Painswick (Watkins), Stroud (Stephens), Wotton-under-Edge, very common (Perkins), scarce round Bristol (Hudd), Mitcheldean, common (Searancke), Lower Guiting (*teste* Stainton). HANTS: Isle of Wight—Bembridge (Stainton), Lymington (Hawes), New Forest—Rhinefield (James), Lyndhurst (Simes), Bournemouth (Robertson), Brockenhurst Whittle), Winchester, common (Hewett), Portsmouth district (Pearce), Ringwood, Hambledon Hill (Fowler), Bank near Brockenhurst (Carr). HEREFORD: Hereford (Bowell), Tarrington (Wood), Leominster (Hutchinson). HERTFORD: Hertford (Stephens), Hitchin, Sandridge (Griffith), Aldbury Down (Barraud), Haileybury (Bowyer), East Barnet (Sillum), Grove Wood, Tring (Elliman). HUNTS: Monks Wood (Blake). KENT: generally common (Freke), Blean Woods, Swanscombe Park (Whittle), Chatham (Tyrer), Upnor, Strood, Chattenden, Cuxton, St. Margaret's, Dover, Cliffe Marshes, etc. (Tutt), at Bexley formerly (Fenn), Pembury (Jenner-Weir), Tenterden (*teste* Stainton), Isle of Sheppey (Fletcher), Maidstone district (Golding), Deal (Browne), Appledore (Heitland), Shoreham (Carr), Herne Bay (Battley), Folkestone (Pickett). LANCASHIRE: Silverdale (Melvill), Carnforth (Murray). LEICESTERSHIRE: Loughborough (Wieldt), near Harborough (Matthews), Leicester (*teste* Stainton). LINCOLN: Lincoln district, common (Carr). MIDDLESEX: Ruislip, common (Woodbridge), Hampstead (Sharp), Stanmore Common (Barraud), Harrow district (Melvill), Kingsbury (Bond), Harrow Weald, common (Rowland-Brown), Enfield (Sykes), Old Oak Common (Godwin), Isleworth (Meyers). MONMOUTH: Monmouth (Palmer), Tintern, Llandogo (Bird). NORFOLK (Barrett). NORTHAMPTON: Peterborough, common (Morley), Ashton Wold, Oundle (Rothschild). NOTTINGHAM: very common in South Notts, but local (Simmons), Nottingham district (Leivers). OXFORD: Shotover, Cowley, Nettlebed (Geldart) PEMBROKE: Pembroke (Puckridge). RADNOR: Wye Valley, common (Vaughan). SALOP: Shrewsbury (Stainton). SOMERSET: Bedminster (Burton), near Wells common (Livett), Taunton, Sidcot, near Yatton (Hudd), Crowcombe, Bath, Bathampton, Clevedon, Loxby Wood near Bridgwater, Leigh Woods (Prideaux), Weston-super-Mare (Crotch), Yeovil (Parmiter), Cheddar (Whittaker). STAFFS: Madeley (Daltry). SUFFOLK: common (Bloomfield), Old Hall, Bentley, Tuddenham (Burrows), Ipswich (Frost), Stowmarket (*teste* Stainton). Depden near Bury St. Edmunds (Rowland-Brown). SURREY: Locally common in the Reigate district (Tonge), Guildford district, common (Grover), Wimbledon, Reigate (Whittle), Oxshott (Carr), Dorking, Ranmore, Polenden (Oldaker), Clandon (Pickett), Frensham district (Bingham-Newland). SUSSEX: West Sussex, not uncommon (Fletcher), East Sussex, generally common (Jenner), Bognor, Pagham, common (Lloyd), Hastings district, common (Bloomfield), Eastbourne (Sotheby), Polegate Downs (James), Brighton, Lewes, Worthing (*teste* Stainton), St. Leonards (Oldaker), Poynings (Image), Steyning (Bird), Burgess Hill (Dollman), Hailsham (Whittle). WARWICK: not uncommon—Hay Woods (Ellis), Warwick (Baly), Rugby, Brandon Woods (Rugby lists), Ettington (Keighley-Peach), Wolford (Wheeler). WICKLOW: Powerscourt (Birchall). WILTS: Savernake Forest (Kimber), Salisbury district common (Carr). WORCESTER: common throughout (Fletcher), Worcester (*teste* Stainton). YORKS: Thorne, very common (Porritt), Askham Bog (Prest), Bishop's Wood (Grassham), Bramham (Smith), Filey (Tyers), Scarborough (Rowntree), Sheffield (Doncaster), Wakefield (Talbot), York (*teste* Stainton).

DISTRIBUTION.—Central and Southern Europe, Scandinavia, Mauretania, Asia Minor, Syria, Armenia, northeast Persia, Transcaspia (Tura), southeast Bokhara, Fergana, ? Pamirs, Ussuri (Staudinger). AFRICA: Mauretania (Staudinger). ASIA: Asia Minor, throughout (Rebel), Broussa (Fountaine), Syria, Akbès (Oberthür), Hermon dist., common in the Lebanon and Antilebanon mts. from 3000-5000 ft. (Nicholl), Patara, Macri, Amasia (Rühl), Achal-Tekke dist., Germob and Nochur, Astrahabad, Pamir dist. (Rühl). AUSTRO-HUNGARY: Vienna dist., Kuhlenburg (Rowland-Brown), Carinthia—Villach (Lemann), Buda-Pest dist., common (Nicholson), Trieste (Mathew), Tyrol—Mendel, Brenner, etc. (Rowland-Brown), Botzen (Lowe), Carlsbad (Becher), Brüun, Salzburg, Grossglockner, Fünfkirchen, Grosswardein, Alterburg, Transsylvania, Lipnik (Rühl). BELGIUM: Ardennes (Rühl), Rochefort (Carlier), Warnant, Fond d'Arquet, Bouge, Dave, Profondeville (Lambillion), Dinant (Lenoir), Malonne (Fabianus), Houffalize Haute Marlagne (Derenne). BOSNIA AND HERCEGOVINA: Dervent (Hilf), Vlasic Planina (Werner), Pale (Apfelbeck), Sarajevo (Mitis), Trebevic (Rebel), Maklenpass (Hilf), Volujak (Apfelbeck), Stolac (Winneguth). BULGARIA AND EAST ROUMELIA: Sophia, Kopaleny, Kloster (Rebel), Rilska Valley (Nicholl), Rilo (Elwes), Rasgrad (Markowitsch), Varna and Slivno

common (Rebel). Channel Islands: Jersey—St. Brelades (Piquet). Denmark: Funen, Jutland, North Zealand, Skov-Kanter (Bang-Haas). [Finland: southern Finland, rare (Zetterstedt).] France: throughout (Tutt), Brittany, common (Griffith), coast from Cancale to St. Malo, Monterfils, Rennes (Oberthür), Pont de l'Arche (Dupont), Tancarville (Leech), Manche, Cherbourg (Nichollet), dept. Nord (Paux), Agincourt (Rowland-Brown), Paris dist., Bois de Boulogne (Oberthür), Fontainebleau (Tutt), Seine-et-Loire (Constant), Aube (Jourdheuille), Indre—Brenne (Martin), Allier dept. (Peyerimhoff), Loire-Inférieure (Bonjour), Vienne, Charroux (Oberthür), Auvergne dist., common—Nohant, Sologne, St. Florent, Guérit (Sand), Cevennes dist.—Balsièges (Rowland-Brown), Isère dist.—Uriage (Oberthür), Dauphiny Alps (Forbes), Savoy Alps—Grésy-sur-Aix, Chavoire, Bourg St. Maurice, Basses-Alpes—Larche (Tutt), Digne (Oberthür), Entrevaux (Powell), Aude (Mabille), Alpes-Maritimes, abundant—Nice, etc. (Bromilow), Beaulieu, St. Martin Vésubie (Rowland-Brown), Hyères (Powell), French Pyrenees, up to 5000 ft. (Bath), general—Le Vernet (Rowland-Brown), Gavarnie, Gèdre (Bath), Cauterets (Oberthür), Haute-Garonne (Caradja), Gironde (Brown). Greece: Corfu (Norris), Mesolonghi (Fountaine), Acarnania, Parnassus, Veluchi (Rühl). Germany: Wiesbaden (Prideaux), Baden, throughout (Reutti), Bremen, Elberfeld, Hamburg, Pomerania, Brieg, Dresden, Chemnitz, Leipzig, Dessau, Oberharz, Cassel, Thuringia, Ahrthal, Kissingen, Regensburg, Kempten, Constance (Rühl), Alsace (Peyerimhoff), Oberwyk (Oberthür). Netherlands: not rare (Snellen), Breda (Heylaerts). Italy: Tuscany, throughout very common (Stefanelli), Apennines near Boscolungo, Certosa di Pesio (Norris), Lombardy, Abruzzi (Rühl), Piedmont—Bobbie, Torre Pellice, Pré St. Didier, Courmayeur, Val Véni (Tutt), Orta (Lowe), Susa (Rowland-Brown), Sicily—Taormina (Fountaine), Osimo (Spada), Ficuzza (Calberla), Castelbuono, S. Martino (Struve). Roumania: Slanic, Valeni, Dulcesti, Dorna (Hormuzaki), Comanesti, Tultscha (Caradja). Russia: Baltic Provinces, very rare, Livonia (Lienig), Tambow, Simbirsch, Orenberg, Kasan (Rühl). Scandinavia: Norway, Saeterstoen, etc. (Standen), Sweden (Lampa). Spain: Escorial (Oberthür), Castile, Aragon, abundant, Bejar dist., Piedrahita, Sierra de la Demanda, Canales, Moncayo, Tragacete, common (Chapman), Grenada (Rambur), Catalonia, Mt. Sény (Witty), Gibraltar (Walker), Barcelona, Montserrat (Standen). Switzerland: Generally distributed and common up to 4000 ft., occasionally higher, *e.g.*, Zermatt, near Sépey (Wheeler), Yvonne (Tutt), Bérisal (Sheldon), Muhlenen, Kandersteg, Randa, Aigle (Bath), Villars (Moss), between Fiesch and Brieg (Pearson), Val d'Herens, between Useigne and Evolène, Saas-Thal—Stalden, Hüteck, Balen, Saas-Grund (Tutt), Zürich (Rühl), Guarda, Fusio (Chapman). Turkey: Port Baklar (Walker), Gallipoli (Mathew).

## Genus: Thymelicus, Hübner.

Synonymy.—Genus: **Thymelicus,** Hb., "Verz.," p. 113 (1816); Stphs., "List," 1st ed., p. 22 (1850); 2nd ed., p. 20 (1856); Kirby, "Syn. Cat.," p. 609 (1871); Rühl, "Pal. Gross-Schmett," pp. 639, 828 (1895); Tutt, "Brit. Butts.," p. 132 (1896). **Papilio,** Rott., "Naturf.," vi., p. 30 (♀) (1775); Schneid., "Sys. Besch. Eur. Schmett.," p. 274 (1785); Hb., "Eur. Schmett.," pl. xcvi., figs. 488, 489 (♂), 490 (♀) (1802), text p. 73 (*circ.* 1805); Ochs., "Die Schmett.," i., pt. 2, p. 231 (1808); Freyer, "Neu. Beit. Schmett.," vii., p. 56, pl. 631, fig. 3 (1858). [**Papilio-Plebeius-**] **Urbicola,** Esp., "Schmett. Eur.," i., pl. xxxvi. (supp. xii.), fig. 4 (1777), p. 345 (1779); Bergstr., "Nomenclat.," p. 37, pl. lxxxix., figs. 6-7 (1780); Goeze, "Ent. Beit.," ii., pt. 3, p. 117 (1780). [**Papilio-**] **Urbicola,** Bkh., "Sys. Besch.," i., pp. 182, 286 (1788). **Pamphila,** Oken, "Lehrb. Zool.," i., p. 759 (1815); Wood, "Ind. Ent.," p. 9, fig. 79 (1839); Humph. and Westd., "Brit. Butts.," p. 129, pl. xli., figs. 5-7 (1841); Dbldy., "Syn. List," p. 2 (1850); Westd. and Hewitson, "Gen. Diurn. Lep.," p. 52 (1852); Sta., "Man.," i., p. 67 (1857); Kirby, "Eur. Butts.," p. 22 (1862); p. 66 (1882); Buckl, "Larv.," etc., i., p. 135, pl. xvii., fig. 2 (1886); Meyr., "Handbook," etc., p. 359 (1895). **Hesperia,** Ochs., "Die Schmett.," iv., p. 34 (1816); Latr., "Ency. Méth.," p. 772 (1819); [God., "Hist. Nat.," ii., pl. xxvii., figs. 3-4, p. 217 (1821)]; Bdv., "Eur. Lep. Ind. Meth.," p. 27 (1829); Meigen, "Eur. Schmett.," p. 62, pl. 56, figs. 6*a-b* (1830); Treits., "Die Schmett.," x., p. 248 (1834); Bdv., "Gen. et Ind. Meth.," p. 35 (1840); Dup., "Cat. Meth.," p. 35 (1840); H.-Sch., "Sys. Bearb.," p. 159 (1846); Led., "Verh. zool.-bot. Ges.," ii., p. 26 (1852); Curt., "Gen. Brit. Lep.," pl. iv., fig. 20 (1858); Speyer, "Geog. Verb.," p. 287 (1858); Hein., "Schmett. Deutsch.," p. 117 (1859); Staud., "Cat.," 1st ed., p. 15 (1861); Newm., "Brit. Butts.," p. 173 (1870); Snell., "Die Vlind.," p. 86

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*Photo. by Hugh Main.*

THYMELICUS ACTEON.

## Plate IX.

*(To be bound facing Plate IX.)*

Thymelicus acteon.

Fig. 1.—Larva (June 15th, 1906) ×1.

Fig. 2.—Larva in puparium (July 1st, 1906) ×1.

Fig. 3.—Pupa in puparium (July 4th, 1906) ×1.

Fig. 4-5.—Pupa removed from puparium ×1.

Fig. 6.—Imago newly-emerged (July 17th, 1906).

Fig. 7.—Lateral view of larva (June 24th, 1906) ×2.

Fig. 8.—Dorsal view of larva (June 24th, 1906) ×2.

Fig. 9.—Pupa (July 15th, 1906, colouring before emergence) ×2.

(1867); Staud., "Cat.," 2nd ed., p. 35 (1871); Mill., "Cat. Lep. Alp.-Mar.," p. 116 (1872); Curò, "Bull. Soc. Ent. Ital.," vi., p. 216 (1874); Frey, "Lep. Schweiz," p. 55 (1880); Lang, "Butts. Eur.," p. 352, pl. 81, fig. 11 (1884); Kane, "Eur. Butts.," p. 147 (1885); Dale, "Britt. Butts.," p. 217 (1890); Barr., "Lep. Brit. Isl.," p. 283, pl. xxxvii., figs. 3-3*d* (1893). **Thymelinus**, Stphs., "Ill. Haust. Lep.," iv., p. 405 (1834); Westd. and Humph., "Brit. Butts.," p. 125 (1841); Westw., "Butts. of Gt. Britain," p. 128 (1855); Kirby, "List Brit. Rhop.," p. 3 (1858). **Heteropterus,** Ramb., "Faun. And.," p. 307 (1837); "Cat. Lep. And.," p. 87 (1858). **Adopæa,** Watson, "Proc. Zool. Soc. Lond.," p. 98 (1893); Grote, "Proc. Sth. Lond. Ent. Soc.," p. 59 (1897); Kirby, "Handbook," etc., iii., p. 22 (1897); Staud., "Cat.," 3rd ed., p. 92 (1901); Lamb., "Pap. Belg.," p. 272 (1902).

This genus is very near *Adopaea*, Billberg, from which, indeed, it is difficult to separate it except by detailed reference to the early stages. The genus, as originally constituted by Hübner, was not so hopelessly heterotypical as are some of Hübner's genera, since his species are practically confined to our tribe *Thymelicidi*, and his diagnosis reads (*Verzeichniss*, p. 113) as follows:

Die Flügel fast ganz gelb und ungefleckt—*Thymelicus actaeon*, *T. pustula*, *T. vibex*, *T. venula*, *T. virgula*, *T. vitellius*, *T. linea*, *T. puer*.

In 1834, Stephens restricted (*Illus. Brit. Ent.*, iv., p. 405) the genus to *acteon* and *linea* [an evident printer's error, however, making him spell the genus *Thymelinus*,*] and the restriction was confirmed by the same author in 1850 and 1856 (*List*, 1st and 2nd eds., p. 22 and p. 20); the type was fixed in 1858 by Kirby as *acteon* (*List Brit. Rhop.*, p. 3). Our British representative of the genus, *acteon*, shows, in its egg, a less departure from the more typical upright egg of *Augiades sylvanus*, having less of the general appearance of the flat egg exhibited by *Adopaea* (*lineola* and *flava*), and being dome-shaped, although still an egg with three axes of different lengths, whilst the surface sculpture is much stronger and more nearly like that of the egg of *Augiades* (*sylvanus*) and *Urbicola* (*comma*). As in the other Thymelicines the imago is wanting in the hooked antennæ of the Urbicolines (*sens. rest.*). The androconial streak, too, is better developed than in *Adopaea*.

## THYMELICUS ACTEON, Rottemburg.

SYNONYMY.—Species: **Acteon,** Rott., "Naturf.," vi., p. 30 (♀) (1775); Esp., "Schmett. Eur.," i., pl. xxxvi. (supp. xii.), fig. 4 (1777), p. 345 (1779); Goeze, "Ent. Beit.," ii., pt. 3, p. 117 (1780); Staud., "Cat.," 2nd ed., p. 35 (1871); Curò, "Bull. Soc. Ent. Ital.," vi., p. 216 (1874); Rühl, "Pal. Gross-Schmett.," pp. 639, 828 (1895); Staud., "Cat.," 3rd ed., p. 92 (1901); Lambill., "Pap. Belg.," p. 272 (1902). **Actæon,** Bergs., "Nomenclatur, etc.," p. 37, pl. lxxxix., figs. 6-7 (1780); Schneider, "Sys. Besch. Eur. Schmett.," p. 274 (1785), etc. [All other references mentioned under the generic synonymy (*suprà*, pp. 116-117) are referable to *actaeon*.]

ORIGINAL DESCRIPTION.—*Papilio acteon* (*Plebeius Urbicola*).—Very similar to *Papilio thaumas*, Hufnag., or *Papilio sylvestris*, Poda, and I still entertain doubts as to whether it should be considered a distinct species. It differs from *P. thaumas* as follows:—It is rather smaller, the upperside of all four wings is much darker, and nearly brown; the underside, however, is coloured like *P. thaumas*. The forewings are marked with a curved yellowish spot, forming almost a semicircle, the extremities of which are curved towards each other. This spot is not

* It is interesting to see how authors copy from their predecessors. This spelling error was copied in turn by Westwood, Humphreys and Kirby, before the original spelling was again corrected by our British authors.

far from the outer margin; it starts from the upper, but does not extend to the lower, margin, terminating in the middle of the fore-wings. This spot is visible both on the upper- and undersides, but is rather less distinct beneath. This butterfly has no black comma, like the male of *P. thaumas*, but it more resembles the female of the latter.* I have never taken this insect myself, but I lately received two specimens from a friend from Landsberg-on-the-Warthe. As this species is never found in our neighbourhood, although *P. thaumas* is found here every year in abundance, and the above described differences are found in all the specimens of this species which I have seen in the possession of my friend, it seems to me probable that this butterfly is a distinct species, and not a mere aberration of *P. thaumas* (Von Rottemburg, *Der Naturforscher*, vi., pp. 30-31).

Imago.—22mm.-27mm. All four wings orange-brown tinged with fulvous, and irrorated with dark fuscous; on forewings, an elongate, longitudinal blotch of paler orange in the discal cell, a transverse, similarly coloured crescentic series of pale spots forming the angulated line, just outside the cell; ♂ with a well-marked andro-conial streak; traces of a row of paler dots sometimes parallel to hind margin of hindwings; the margins of all the wings narrowly black; nervures indistinct; fringes yellowish-grey. The undersides almost uniform greenish-grey to orange-yellow, the inner margin of forewings blackish, and the apex yellowish.

Sexual dimorphism.—The sexual dimorphism in this species is most marked, the ♂ possessing a well-developed androconial pocket, passing obliquely beneath the median nervure of forewing towards the inner margin, much resembling that of *A. flava*; the pale longi-tudinal discal spot, the crescentic series of pale spots (forming upper portion of the angulated line), and the transverse band of pale spots crossing the centre of the hindwing is much less distinctly marked (often absent) in the ♂ than the ♀ (although the latter sex varies greatly in this respect). The ♀ appears to be, on the whole, a larger and more heavily built insect than the ♂.

Gynandromorphism.—The following is the only gynandromorphic example we can trace:

Left side ♂, right side ♀. Captured at Swanage, July 16th, 1903 (Ford, *Ent.*, xxxvi., p. 242).

Variation.—The species is distinctly not a variable one, although, as already noted, some variation occurs both on the undersides and uppersides of the wings. In the former, some are much greyer in tone, others more orange, the former inclining to greenish-grey, the latter to orange-yellow, and whilst the former have a fairly well-developed, bright, inner marginal patch on the hindwings, in the more brightly tinted ones this is lost in the ground-colour. On the upper-side, the variation chiefly consists in the depth of the ground-colour, some having an excess of dark fuscous, and hence becoming darker than usual, others more orange or golden-brown in their tint, and hence being brighter in hue, whilst extreme British ♂s are very dark and tinged with green = ab. *virescens*, n. ab. There is also, in both sexes, considerable variation in the conspicuousness (or otherwise) of the pale markings, whilst in some examples there are well-developed traces of pale

* Evidently it is the female that Von Rottemburg describes.

markings on the hindwings, not present at all in others. Von Rottemburg mentions none in his description, so that this form is the type, whilst that with marks on the hindwings, might be called ab. *distincta*, n.ab.; very rarely they are absent on both fore- and hindwings. The variation in this direction, therefore, may be noted as:

1. With distinct pale marks on fore- and hindwings =ab. *distincta*, n.ab.
2. ,, ,, ,, ,, on forewings only =*acteon*, Rott.
3. ,, ,, ,, ,, absent on fore- and hindwings=ab. *obsoleta*, n.ab.

There are two very marked forms in ground-colour, apart from the more marked presence or absence of the paler markings, *viz.*, (1) the more typical form with distinctly more fuscous in the ground-colour, and (2) a more golden-brown form, the paler marks blending more markedly with the ground-colour=ab. *clara*, n. ab. We have seen such forms from Grésy-sur-Aix, Chavoire, and Bourg St. Maurice. Very rarely the angulated row of pale spots on the forewing unites with the discocellular spot, making a blotch that occupies the greater part of the costal area of forewing from the angulated row of spots almost to the base=ab. *extensa*, n. ab. Specimens (♂ and ♀) are in our collection from Chavoire. Oberthür remarks that marked aberrations are very rare, only individuals that are lighter or darker than usual occur in his collection. Rühl notes that the Tunisian examples are somewhat smaller and the uppersides darker than usual, whilst he adds that the Algerian specimens are paler, more yellowish than brown.

Egglaying.—The eggs are deposited low down on the dried leaves of the foodplant and hatch in about fourteen days (Rühl). This may be accurate; until now we have quite failed to discover eggs laid naturally, nor have we been able to detect a ♀ depositing her eggs, but a single egg laid in a chip-box, July 21st, 1905, developed its larva in about a fortnight, but the latter has not yet hatched (October 1st, 1905), and one suspects that the young larva may live all the winter inside the eggshell.

Ovum.—Of a pale pearly-white tint, tinged slightly with yellow, of flat type in outline, *i.e.*, with three unequal axes, but with micropylar axis at right angles to plane of deposition. It is distinctly oval in outline seen from above, and more dome-shaped than the eggs of *Adopaea* (*lineola* and *flava*) viewed from the side; the edges more rounded, the top with a slight median micropylar depression; the surface shiny, pitted, and with distinct surface reticulation, the pits apparently inclined to fall into longitudinal rows from apex to margin (Tutt, July 22nd, 1905). The egg has much the appearance of a Geometrid egg, perhaps in shape and outline more like that of *Trochilium* (*bembeciforme*), *i.e.*, it has an oval outline as seen from above, and is not so tall and wide. At first sight it appears to be unquestionably a "flat" egg. This, however, is not so. The length of the egg is 1·05mm., the width 0·70mm., and the height 0·58mm., the bottom is rather flat and the upper surface is rounded, so that half way from the centre to the margin (in any direction) the height is only 0·55mm. The young larva appears to be developed within it, and the colour is dark at one end (larval head), the rest greyish, the egg is not very transparent, but sufficiently so to allow one to arrive at this conclusion as to the larval development with some confidence, though it may be that the egg is addled and the material irregularly aggregated. The sculpture of the egg is a set of irregular polygons,

largely triangular, in one or two places three or four squares are seen in a row, but for the most part no regularity is observable. Their average diameter is 0·034mm. The lines forming the mesh are raised and rounded and about 0·004mm. in width; at many points of intersection is a slight elevation as of a knob, a hint of the raised knobs of Lycænid eggs. The micropylar area is a very definite and neat little rosette about 0·005mm. in diameter. It is situated at the centre of the upper surface of the egg, showing it to be an upright egg, though of so unusual a shape (Chapman. Described from the same egg, September 13th, 1905).

Habits of larva.—As we have just noted, this species probably hybernates in the egg stage, the larva hatching in the very early spring, although Rühl says it hatches in the autumn and lives in rolled-together leaves. By early May in forward seasons the larvæ may be already found in rolled leaves of *Brachypodium pinnatum* in its Dorset haunts; they are then variable in size, and may be collected freely until well into June, in Purbeck. The larva, at any rate from an early stage of its existence, lives by day concealed in a cylindrical tube, open at both ends, which it forms by drawing together the edges of a young blade of *Brachypodium pinnatum* along the more central portion of its length, and securely fastening them to one another with white silk, of which the separate transverse stout cords are most noticeable. In this it rests, head upwards, stretched out in a straight line along the middle of the blade, and, when feeding, which it doubtless does only by night, it devours portions of this blade above its tube, beginning at the margins. As it increases in size, it moves to another blade, on which it constructs a fresh tube, and, when fullgrown, it often forms its tube by fastening together the ends of two neighbouring blades of its foodplant along part of their length, thereby securing a more roomy habitation and a larger supply of accessible food. I have never found a pupa in any of the numerous large tubes met with while searching for the larva, or elsewhere (Bankes). In 1879-80-81 I had larvæ sent me by a kind friend at the end of May; they then varied in size from one-fifth to half-an-inch. Without exception they all arrived, and continued to live throughout, in a tube formed by a grass leaf, drawn together by white silk, only coming out to feed. They dwelt in their tube during the day, and fed at night on the tender parts of young grass. . . . They went into pupa in the tube, or made a cocoon by spinning two or three blades of grass together (Hutchinson). They spin together the grass blades and live therein (Parmiter); at rest, they lie very flat on a blade of grass, with the head stretched out in the same plane as the body; when disturbed the larva falls, the two extremities approach each other and the body assumes a crescentic form; the larva can suspend itself by a thread, still maintaining its crescentic form, but as soon as it feels something on which to rest it breaks the connection, resting either in a straight position or fixing itself by its prolegs, holding out its head and anterior segments in a leech-like manner; it appears to feed entirely at night, and then makes large gaps in the grass-blade beginning at the margin and eating its way towards the middle (Newman). The fullgrown larvæ spin a coating of white silk from one side to the other in the middle of a grass-blade, causing the two edges of the blade to draw together a little, and resting in the silk-lined hollow, whence they ascend high up the blades of the grass,

eating out wedge-shaped portions from the side which cuts off the pointed tip, leaving an oblique edge above, and also eating away other wedge-shaped pieces from the side of the blade (Buckler). At Meseritz, in nature, they feed on the small wood-reed, *Calamagrostis epigeios*, chiefly under the shade of fir-trees, making deep notches in the edges of the leaves which help to betray their proximity, feeding in the evening and at night, and resting in the daytime extended along the flat surface of the leaf (Zeller). They are fullfed from about the middle of June onwards, when they spin their puparia (Buckler, June 23rd, 1873). Larvæ have been taken many times in the spring and early summer months in the Isle of Purbeck by Bankes, who notes (*in litt.*) dates as follows:—May 27th, 1885; April 29th, 1890; May 26th, 1890; June 17th, 1892; May 7th, 1894, and June 7th, 1905.

Larva.—*Young larva:* When young the larva is whitish-green with green median longitudinal line, and black head; later with green lateral lines, red-brown prothoracic stripe and green head, etc. (Rühl). *Penultimate* and *Final instars:* The larva is green in colour in the penultimate instar (length 12·5mm.), finely studded with minute black skin-points, in the last instar (22mm. when stretched) the skin-points are practically invisible except in front, but when detected are seen to be mere white down or very fine hairs, at any rate colourless or nearly so. These differences (of size and skin-points) are the chief between the two stadia. In the penultimate the larva rolls one or two blades of grass so as to form a tube, using a good deal of white silk. One, wishing to moult and finding the grass too dry and shrivelled, used the muslin cover, which it drew into a tube with chiefly six strong transverse cables. The head has a slight fuscous tint, is very rounded and minutely shagreened, and shows abundant very minute hair-points. The colouring is in longitudinal stripes, but the elements of these stripes are largely transverse yellow lines occupying the subsegments. No primary tubercles can be made out. There is a broad dorsal stripe, green, the next line (narrower) being yellow, and it has an indication of a faint yellowish line down its centre, the dorsal line strictly speaking. The lateral line, some way below the pale fawn and inconspicuous spiracles, is whitish, between the dorsal band and the lateral line is first the yellow line bordering the dorsal stripe, and some irregular green and yellow marblings, of which the yellow most affects the two posterior subsegments and forms an intermediate line. The effect is to make this region look less dark than the dorsal band. Each abdominal segment is divided into an anterior (nearly) half, which is indistinctly divided into two subsegments, and a posterior (not quite perhaps) half, divided distinctly into four equal subsegments. On the latter the black skin-points tend to form transverse rows, one row and an imperfect row to a subsegment, on the front half they are less regular. Round the posterior margin (behind anal plate) is a fringe of white hairs, the only really definite hairs on the larva. The underside is rather flattened, more apple-green than the upper, *i.e.*, without yellow. *Final instar:* In the last instar the striping is more definite and less of a marbled character—a fine dorsal line, yellow, shading into broad dark green stripes, then a greenish-white line, next a yellowish-green band, then a narrow yellow line, then a broad space of pale green, in the middle of which is the spiracle—followed by the whitish lateral line. These lines seen dorsally do not converge much at hind extremity. The

double yellow line (outside dorsal band) is yellower in front, and is continued down head on either side as a yellow longitudinal frontal line. Head otherwise green, with six eye spots. The jaws whitish with very dark brown margin and teeth, the cheek behind them forming a yellow and brown marginal area. The surface of the head has a slender clothing of very minute hairs, and is very finely pitted, the margins of the pits run to some extent into lines, looking like a series of waves. The skin-points are very indistinct over most of the surface; on the thorax, however, they present minute black rings, some with very short white hairs, and on the 9th and 10th abdominal segments they again look like hair-points, and graduate into the actual hairs forming the fringe round that end of the larva. There is one hair on the prothorax, at anterior lower angle of plate (if there is one, the texture looks like the rest of the larva). The underside is apple-green in tint, and underneath the 7th and 8th abdominals is already indicated a pale shade, though larva is not yet fullfed. These patches are one on each side, beginning at front of segment and ending in a rounded margin before middle of segment, they are crossed by a slight (intersegmental?) fold. These ultimately shed the white powder at pupation. The larva has little of the marked neck which characterises the Hesperiid section, indeed, it is not noticeable. The thoracic plate in a prepared specimen is seen to be a very narrow transverse strip, with several abortive hairs. It has a transverse ridge, and, in front of this, some raised network markings. The prothoracic segment is definitely narrower than the mesothorax—it has parallel sides, is just wider than head (2·1mm.), but (at rest) is very narrow from back to front (about 0·3mm.). The mesothorax bulges out to 2·8mm. or 3·2mm., and has a rounded margin. The larva is about 3·5mm. wide to 7th abdominal segment—fairly cylindrical, the true legs short and stumpy, hardly tinted ochreous, the prolegs very short on low eminences, so that the larva is almost as round below as above. The prolegs have crochets on about five-sixths of their circle, the unequipped portion being the outer and slightly posterior. They are single and about seventeen in number in front; behind are alternate large and small hooks (in one row), and about sixteen or seventeen of each. The outer and inner bosses (basal eminence and shaft or pillar) form one rounded base, divided by a line, each has rather numerous very fine hairs, and there are a few above and in front of the base. Lenticles are not very definite, but circles (or ovals) entitled to be so called occur (1) at bases of the legs, (2) on dorsum (tubercle i?) of mesothorax, and (3) on abdomen above situation of v and of vi, *i.e.*, two at about equal distances below spiracles. The anal plate is colourless (green), and reticulated with similar sculpture to that of head and prothoracic plates. There is a supra-anal comb about 0·4mm. long and 0·3mm. wide with about twenty teeth (Chapman, June, 1905). *Final instar* (June 23rd, 1873): 19mm.-22mm. in length, in figure (omitting the head) tapered a little to each end, the prothorax being the smallest and very short. The head swells out beyond the size of the prothorax, but not to such an extent as in some other allied larvæ (Buckler). Of a pale greyish-green, the dorsal vessel darker, edged with a slender pale yellow line on each side, and enclosing a pale longitudinal line along its middle. A narrow yellowish line runs above on the side, and a broader one below. The two dorsal lines are prolonged as far as the

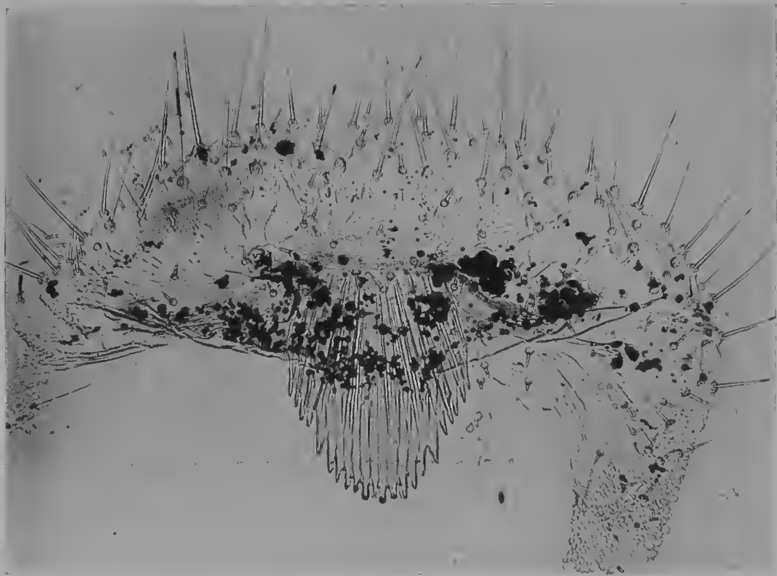

*Photo. F. Noad Clark.*

LARVA OF THYMELICUS ACTEON (PENULTIMATE INSTAR) ANAL COMB × 50.

*Natural History of British Butterflies*, Dec., 1906.

middle of the head and run to the end of the flat anal shield, which is narrowly edged with pale-yellow. The transverse folds of the skin are yellowish. The head is rounded with inflated cheeks, the brownish mouth sunk deep between them. The colour of the head (brown in the young larva) is pale, with the two yellowish lines very distinct and exteriorly edged with greenish (brown also in the young larva), with lines stouter and paler and without darker edges. The legs are very short and greenish, the ventral ones having usually a longitudinal yellowish stripe. The two snow-white patches on the underside of the 6th and 7th abdominal segments are conspicuous, as in *lineola*, *sylvanus* and *comma*. This white substance is spread out at the anal end of the larva of *actaeon* when it has formed its puparium (Zeller). The spiracles are pale flesh-colour, situated on a faint and pale line, which touches them in front, and vanishes behind each spiracle; the lower pale stripe is inflated and rather overlaps the ventral prolegs; the surface of the head and body is slightly roughened with minute granulations, especially on the thoracic and three terminal segments, which bear a number of minute black points; the rest of the upper surface is faintly freckled with rather darker green than the pale ground; the ocelli are black; the anal shield fringed with a few fine hairs. As the larva matures its glaucous tint gives way to a paler and more yellowish green (Buckler). [The larva is figured by Buckler, *Larvae*, &c., i., pl. xvii., figs. 2-2*a*.]

Foodplants.—*Brachypodium pinnatum* (not *B. sylvaticum* in nature in Britain) (*Ent. Mo. Mag.*, xxii., pp. 138-9) (Buckler), *B. sylvaticum* in confinement (Parmiter and Hutchinson), *Triticum* (*Agropyron*) *pungens*, *T. junceum* in confinement (Buckler), *Calamagrostis epigeios* (Zeller), *Triticum repens*, oat- and canary-grass in confinement (Newman), *Poa annua* (Rühl).

Puparium.—The fullgrown larvæ seek for a retired shelter, which they find in a corner between some leaves on which they form a spacious habitation by spinning in the open parts a thin wall of whitish web, with large and very irregular meshes, the resting-place being thickly covered with whitish silk, but most thickly where the tail of the larva is to rest, pupation taking place in four or five days (Zeller). They also construct close retreats within the outer space, formed by two or three blades of grass crossing each other. These they fasten together with silk, and within it spin a silken carpet, to which they attach themselves, making also a fine cincture of white silk that is drawn tightly round the front of the pupa after pupation has taken place, the cincture being secured a little behind to each side of the chamber by a thickening of the silk. The few stout threads that cross over the pupa at each end, more or less obliquely, do not touch it at all, but serve as security for its habitation, and possibly as protective outworks whilst it lies fastened on its silken carpet (Buckler). The pupa is enclosed between two or more grass blades, drawn closely together and lined with silk so as to form a cocoon; still the blades over the back are but slightly drawn together, and are easily removed, leaving the pupa in the hollow of a leaf, attached much like a Papilionid or a Pierid. Under the pupa, the silken mat is strong and continuous, and extends 3mm. or 4mm. beyond the pupa at either end; there is rather more silk under the cremaster, forming a pad, not nearly so definite as in that of a *Papilio*, etc., but still entitled to be recognised as a specially thickened position in the silken mat. The pupa is also

encircled by a girth which impresses the wings a little, and, leaving them at the anal angle, crosses the back in the incision between the 2nd and 3rd abdominal segments, in which it is quite invisible (Chapman). The pupa is slender and agile, and the pupal stage lasts a fortnight (Zeller).

Pupa.—The pupa is of a lively apple-green of several tints, the head, thorax, and appendages are transparent, if not quite glassy, and the colour is bluish-green, depending entirely on the fluid contents—the nose-horn has a pinkish shade, which is cutaneous colouring, the pen of the cremaster is also faintly margined with pinkish, and for the rest is colourless, as if the translucent white cuticle contained colourless fluid. The rest of the abdomen is of a more solid aspect, and rather yellowish tint. The broad dorsal band is of much the same colour as the thorax, however, but has a very fine yellow central line, it is bordered by a line which is yellow by comparison, but really apparently a green, and there is another similar line half way between this and the spiracles; these lines proceed forward over the mesothorax, but fade out before reaching the prothorax. The pupa is 19mm. long and 3·8mm. across the widest part (wing-bases). The head is broad and square, and about 3mm. across. The nose-horn arises at the middle of the dorsal margin, its dorsal line being continuous with that of the pupa, but ventrally, there is, beneath it, a breadth of nearly 1mm. of the head, whose surface is directed to the front. The horn is 1mm. wide at base and abont 1·3mm. long. The line of the glazed eye resembles that of a Sphingid, *viz.*, the curvature is directed forward. Seen laterally it has very much the appearance of a human eye (in a marble statue) due to the glazed part being very wide, and contrasting in texture with the portions above and below that look like eyelids. The median angles of the maxillæ come very far forward in front, but not quite on the anterior aspect of the head. Until the maturation of the imago commences the wings are so transparent that the tracheæ of the venation can be easily made out, as well as the superficial impress of the venation on the surface. The apices of the wings reach to nearly the posterior margin of the 4th abdominal, and beyond this there extend, as a free style, the ends of the maxillæ, reaching beyond the middle of the 6th abdominal, this portion, as well as a portion between the wings as far back as the upper border of the 4th, being tinted red-brown. The antennæ descend as far as two-thirds down the wings; the first legs about as far, but they are entirely cut off from the antennæ by the second legs. All these parts are very difficult to make out, the underlying tracheæ being more conspicuous than the superficial sutures. There are no hairs to be detected by using a strong hand-lens. The cremaster is a small dense patch of short reddish hooks beneath the extremity of the 10th abdominal segment (Chapman, July, 1905). Slender, about 19mm. in length, 4mm. across the arched thorax, where it is widest, though the head, with its large prominent eyes, is almost as wide; the top of the head is a trifle flattened, and has a beak-like process projecting forwards of a flattened triangular shape, its base lying across the head between the eyes; the abdomen tapers very gradually towards the anal portion, which ends in a prolonged and blunt flattened tip, furnished with a circlet of exceedingly minute recurved hooks. The wings, antennæ and legs are plainly developed, and the proboscis is extended at full length down the abdomen, from

which it lies wholly free towards its extremity. Its colouring at first, and up to within four days of the advent of the imago, closely resembles that of the last larval period, *viz.*, a very pale and delicate yellowish-green, on which all the lines of the larva, though faint, are distinctly to be seen. The first indication of its approaching change is a gradual suffusion of pink over the thorax, which, with the wing-covers, in 24 hours, becomes of a dingy greyish-purple hue, the back of the abdomen a light brownish-olive tint, the divisions appearing as paler rings, the beak and tail purplish-grey. In this advanced stage, the change of colour is considerable even in an hour or two; it grows by degrees deeper olive on the back of the abdomen, with a dingy purple dorsal stripe; as the body and thorax darken to purplish-black, so, in proportion, do the frontal and caudal projections fade away to a greyish-ashy paleness, and become semitransparent, as though empty; finally, the surface becomes as though covered generally with a misty reddish-grey bloom (Buckler). [The pupa is figured by Buckler (*Larvae*, etc., i., pl. xxii., figs. 2*b*-2*c*.)]

Time of appearance.—Although this species is on the wing for a considerable period every year, it appears to be everywhere throughout its range single-brooded. In Tunis, it is recorded as appearing as early as March and April, in the Beyrout district early in May, in Greece and Sicily at the end of May and June, in southern France and Spain in June, rarely in May, in Crete in June, yet its time of appearance in Central Europe is much as in England, varying from June to August, according to the season, and lasting over from six to eight weeks each year, the average time being the last three weeks in July and the first week of August for fine specimens. The idea that the species is double-brooded in Britain* is erroneous; in early seasons, *e.g.*, 1893, the species is out by the last week of May (May 31st, 1893, in Purbeck), and lasts well into July; in late seasons, *e.g.*, 1888, it was not out until August and lasted well into September (September 8th, in Purbeck). We have not been able to collect many actual dates, but those we have exhibit considerable variation. Amongst others we note: Continental records—In 1893, first seen on June 29th at Nice (Bromilow), a month after its appearance in England the same year (Bankes), and six weeks later than its appearance at Hyères, May 17th, 1905 (Sheldon); July 28th, 1894, at Courmayeur (Tutt); June 6th, 1897, at Canea, in Crete (Mathew); June 12th and 13th, 1898, at Blagaj, about eight miles east of Mostar (Mrs. Nicholl); August 17th, 1898, between Morgex and Aosta, worn (Tutt); first week in September, 1898, a good deal worn, at Brigue (Wheeler); June 3rd-18th, 1899, at Digne; June 23rd, 1899, at Susa (Rowland-Brown); July 19th, 1899, at Sierre (Wheeler); common, July 12th-20th, 1900, at Herculesbad (Lang); May 3rd, 1900, in the Beyrout district (Nicholl); common, June 2nd, 1900, in Crete (Fletcher); in June, 1900, at Mesolonghi (Fountaine); August 19th, 1900, at Grésy-sur-Aix, worn (Tutt); July 29th, 1901, at Mende (Rowland-Brown); June 6th, 1902, May 30th-June 14th, 1903, at Hyères, June 21st, 1902, at Ste. Maxime (Powell); July 29th-31st, 1902, at Chavoire (Tutt); June 23rd, 1903, at Guéthary

* This idea originated with Hearder (*Ent. Mo. Mag.*, xx., p. 227) and Dale (*Ent. Mo. Mag.*, xxviii., p. 164), but all the evidence is against the assumption, and the latter's account of the life-history in two broods (*Hist. Brit. Butts.*, p. 218) is quite imaginary (see *Ent. Mo. Mag.*, xxix., p. 214).

(Chapman); July 26th, 1903, at St. Martin Vésubie (Rowland-Brown); July 28th, 1904, at the foot of the Grand Salève; July 29th-31st, 1905, quite worn, at Grésy-sur-Aix; August 3rd-5th, 1905, in fine condition, at Bourg St. Maurice; August 19th, 1905, at Chatillon, quite over (Tutt); August 3rd, 1905, at Gavarnie (Turner. British records—August 15th, 1832, at Durdle Cove, near Lulworth Cove (Dale); August 2nd, 1847, at the Burning Cliff (Stevens); July, 1849, at the Burning Cliff (Douglas); fine at end of July, 1858, worn and over at end of July, 1864, at Lulworth Cove, etc. (Blackmore); July 27th, 1867, at Lulworth (Dale); imagines bred July 14th-18th, 1873, from wild-captured larvæ (Buckler); July 12th-19th, 1877, at a place 15 or 16 miles east of Lulworth Cove (Goss); June 20th-September 4th, 1879, at Lulworth (Dale); June 16th-July 22nd, 1884, also bred July 15th from larvæ collected in spring; July 16th-August 5th, 1885, July 5th, 1886, August 4th, 1887, September 8th and 11th, 1888, in the Isle of Purbeck (Bankes); throughout August to September 13th, 1888, at Lulworth (Dale); July 13th-August 1st, 1889, June 21st, 1890, in the Isle of Purbeck (Bankes); August 2nd-September 6th, 1890, at Sidmouth (Wells); early August, 1891, at Swanage (Alderson); July 31st, 1891, at Swanage (Raynor); July 8th-15th, 1892, in the Isle of Purbeck (Bankes); well out in the Swanage district on July 12th, 1892, and continued to emerge up to August 8th or 10th (Bright); July 15th, 1892, at Swanage (Mackonochie); July 26th-August 5th, 1892, at Swanage (Alderson); July 29th and August 1st, 1892, at Swanage (Bloomfield); early in August, 1892, near Honiton (Riding); July 28th-August 13th, 1892, at Burning Cliff; August 3rd, 1892, at Lulworth (Claxton); May 31st-July 28th, 1893, in the Isle of Purbeck (Bankes); end of July, 1893, worn, at Weymouth (Claxton); several good ones, August 16th, 1893, at Swanage (Bergman); from August 6th, 1894, at Swanage (Dobrée-Fox); June 13th-July 25th, 1894, June 20th-July 23rd, 1895, June 23rd-July 13th, 1896, June 12th-25th, 1897, in the Isle of Purbeck (Bankes); mid-July, 1897, at Swanage (Bayne); August 4th, 1897, worn specimens at Sidmouth (Studd); August 2nd, 1898, worn, at Sidmouth (Raynor); at Swanage, first fortnight in August, 1898 (Henderson); July 18th, 1899, abundant at Sidmouth (Studd); July, 1899, at Swanage (Robertson); August 1st, 1899, and following days, at Swanage (Kemp); July 10th, 1901, at Swanage (Robertson); July 16th, 1902, at Swanage (Ford); July 21st, 1902, at Swanage (Vinall); June 19th, 1904, locally common at Swanage (Rothschild); August, 1904, at Swanage (Image); July 15th-August 27th, 1904; July 20th-29th, 1905, in the Isle of Purbeck (Bankes); July 14th, 1905, at Swanage (Young); July 21st, 1905, abundant at same place (Bell).

Habits.—The habits of this species are not unlike those of *Adopaea lineola* and *A. flava*, except that it appears to be a distinctly swifter-winged and more restless species than either of them, especially if the sun be really hot; it also appears to be much fonder of flowers than these, although it rests and suns itself in a similar manner. In many respects, the imagines remind one of the rapidly-moving *Urbicola comma*, chasing one another from flower to flower after resting for hardly a moment in the hot sun, following each other through the long grass or hunting away an approaching *A. flava* or *A. lineola*. When sunning, it rests with the hindwings somewhat inclined from the horizontal, the forewings slightly folded along the inner margin and

resting on the hindwings at about an angle of 60° to them; at this time, the inner margin of the forewing rests along the anal nervure of the hindwing much as in *A. lineola*, but the forewings are much more elevated and nearly parallel to each other. Like most of the "skippers" the male loves to drink, and, at a runnel near the bridge at Bourg St. Maurice, on August 3rd-5th, 1905, we captured many, as they sat motionless, imbibing in the hot sun, and practically oblivious of the crowds of *Polyommatus damon* and *P. corydon* that almost stood on them. In a clover-field above Grésy-sur-Aix, on July 31st, 1905, they showed the same restless disposition as on the flower-slopes at Bourg, sitting for a moment sucking the nectar and then flying off rapidly, on the approach of any other butterfly, to their chosen point of vantage to give battle, often returning after driving the offender off. On the borders of a lucerne-field at Chavoire, at the end of July, 1901, where the plants grew tall and sparsely, they were also exceedingly active in the hot sun, sitting for a moment on a lucerne-head, and darting off rapidly to give battle to another of their kind, but returning again and again to nearly the same place; the ♀ s often appear to be in rather better condition than the ♂ s, probably because they emerge a little later and are a trifle less active. At Digne the species was abundant in July, 1901, frequenting the lavender flowers with *Adopaea lineola*. Towards the end of the afternoon and early evening, however, they become less active, settle down on the flowers and become an easy prey; by dusk, however, they disappear into the lowest herbage. Rowland-Brown observes that, at Mende, the imagines particularly affect the brown flowers of a rush on which to rest, and to which their colour offers a close resemblance, and thus affording considerable protection, whilst Fletcher observes that, at Suda Bay, in Crete, they were easily captured as they rested on clumps of rushes. This rush-resting habit appears to be fairly general, for it is noted by Claxton as occurring also at Swanage; he observes that, when freshly emerged, they appear to like to sit on a spray of bramble or on a grass-culm, but later are fond of sitting on teasel-heads, and not infrequently on thistle- and bramble-flowers, to suck the honey; on a dull day they do not fly, and are then to be found at rest on the rushes, but on a bright day are very active and pugnacious, attacking other species of butterflies occurring in their neighbourhood. In its haunts at Lulworth, it is reported as flying very rapidly in the sunshine, in short, sharp, jerky flights, settling on the rough herbage found growing in the localities it affects, or on the *Brachypodium* on which its larva feeds, and darting off rapidly from one point to another at no great distance. It sometimes settles on the ground, whilst Stephens found a few on flowers of thistle and ragwort, although more were seen on the flowers of a *Carex*, that grew in clusters close to the beach, the species being confined apparently, in the Burning Cliff locality, to a space of about 100 yards only; Dale also notes that it affects that part of the undercliff to the east of Lulworth Cove, where *Inula crithmoides* grows abundantly; Goss says the imagines frequent flowers of *Ononis arvensis*, and Bankes that he finds them feeding on thistle flowers in Purbeck.

Habitat.—Distributed as the species is over almost the whole of that part of the Palæarctic area comprising the Canary Isles, the Mediterranean region, southern, central, and southeastern Europe,

and extending throughout Asia Minor, the species has, as may be supposed, a variety of habitats, yet, at whatever latitude or altitude it may be found, its haunts are usually well protected from the cold, and have a dry and sunny situation. In Britain, it is practically confined to the coves and sheltered cliffs and slopes on the southern coasts of Devonshire, Dorset, and Cornwall, and, on the opposite coast of France from Cancale to St. Malo, in similar places, the species is equally abundant. The well known Lulworth Cove locality is an undercliff covered with thistles, large tufts of grass, and tall *Carices*, among which the butterflies skip about briskly in company with *A. flava;* at Swanage it occurs on grassy slopes near the sea, whilst Parmiter observes that the habitats between Swanage and Weymouth are detached places on the downs facing the sea, within one or two hundred yards of the shore, where the subsoil is of chalk or limestone, the chosen haunts having a southern aspect and well sheltered by hills from the north. Goss observes of one of the places where the species is most abundant, that it is some 15 or 16 miles to the east of Lulworth Cove, and forms a platform some 300 ft. in length and 50 ft. in breadth formed by a landslip at no very remote period, on the side of the cliff, at a height of about 130 ft. above the sea; here the ground is extremely rough with masses of rock lying about in all directions, while the vegetation is of a very varied character; Bankes finds it common in many warm spots in Purbeck, both on the coast, and also inland along the southern slopes of the chalk hills, even some miles from the sea. On the Continent some of its chosen haunts are very different; the nearness of the sea is not at all necessary to obtain the warm sun-bathed slopes the insect loves, and hence we find it abounding in localities having quite different positions—the hot sunny slopes on the hills above Grésy-sur-Aix, from the grass of which they invade the adjacent lucerne and clover fields, or purloin the honey from the flowers in the neighbouring orchards; the steep rough banks that edge the top of a lucerne-field that slopes up from the shores of the Lac d'Annecy to the foot of the hills at Chavoire; the rough flower-covered slopes at the foot of the Grande Gorge, at the base of the Grand Salève, near Geneva, the flowering slopes of the valley leading from Bourg St. Maurice to Bonneval-les-Bains; the roadside banks between Pré St. Didier and Aosta; flowery meadows among the lower mountains opposite Chatillon, in the Val d'Aoste, and many other similar and dissimilar places. Bath notes it in the Pyrenees, at St. Sauveur and Héas, at an elevation of from 3000 ft. to 5000 ft. Zeller found it on the edge of a pine-wood at Meseritz, in Posen; whilst, in Hesse-Nassau, and other German states, it appears to be almost confined to dry, warm spots on the chalk-hills, or in pine-forests; and so on. We have no doubt that its more southern and eastern haunts are even more varied; in Syria, it occurs in the Beyrout district in the Dog River valley down to sea-level. So also it does in most of the islands of the Greek Archipelago, Crete and Cyprus; it occurs low down also at Gibraltar, in the cork woods, so that its habitats are seen to be sufficiently diverse in character.

British localities.—Cornwall: near Truro (Benson), [near Falmouth (Dale)]. Devon: extremely local—cliffs east of Sidmouth and Torquay (Reading), Sidmouth (Studd), between Sidmouth and Charmouth, near Honiton (Riding). Dorset:

coast from Punfield Cove near Swanage to Preston Coastguard Station, two miles from Weymouth, the range of hills running through Purbeck, line of chalkhills from Swanage to Upwey, Ridgway Hill, near Upwey (Dale), Isle of Purbeck—Corfe, etc. (Bankes), Swanage (Raynor), Weymouth (Claxton), Burning Cliff by Holworth (Lockey), Durdle Cove near Lulworth Cove (Dale), near Tyneham (Parmiter), near Lyme Regis (*teste* Dale). [SOMERSET: Wookey near Wells (Westcott) (almost certainly *A. flava*).] [WARWICK: Stratford-on-Avon (Colbourne), Shenstone near Lichfield, in 1835, in abundance (Humphreys *teste* Stainton)].

DISTRIBUTION.—Central and Southern Europe (except Russia), Asia Minor, Syria, Mauretania (Staudinger). AFRICA: Canary Isles (Holt-White), Algeria—Oran, Lambessa, Bona, Algiers, Sebdou (Oberthür), Sidi-bel-Abbes, Kasba de Bona, Tunis, Morocco (Rühl). ASIA: Syria—Beyrout district, Dog River valley (Nicholl), Amasia, Taurus, Broussa (Rühl). AUSTRO-HUNGARY; Dalmatia—Zara (de la Garde), Herculesbad (Lang), Transsylvania, the Bukovina—Banat (Caradja), Croatia, Slavonia (Rebel), Bohemia, rare—Carlsbad (Hübner), Prague, near Budweis (Fritsch), Moravia—Brünn (Schneider), Lower Austria—Hernstein district, Piesting (Rogenhofer), Vienna, near Mödling (Speyer), Rosenau (Fritsch), Salzburg—in the lower valleys, rare (Richter), Tyrol—Innsbruck district (Weiler), Botzen, Trient (Mann), near Tratzberg (Fritsch), Carniola—coast districts, Cesta, Locaviz (Mann), Wippach (Speyer), Dalmatia (Speyer), the Unterberg, Glockner district, the Lipnik (Rühl). BELGIUM: Local and rare—Bomal, Montagne St. Pierre (Donckier), Durbuy, Rochefort, Dinant (Lambillion), Han-sur-Lesse (Sibille), Denée (Hennin), Theux (Derenne), Esneux (Rühl). BOSNIA AND HERCEGOVINA: Sarajevo district—Dariva, Reljevo (Rebel), Klekovaca (Apfelbeck), Trebevic (Rebel), Jablanica (Hilf), Blagaj (Nicholl), Nevesinje (Uhl), Bilek (Rebel), Trebinje—Grab (Rebel), Stolac (Winneguth). BULGARIA AND EAST ROUMELIA: near Sophia, Kokaleny-Kloster (Bachmetjew), Slivno, everywhere in the mountain valleys (Rebel). CYPRUS (Rühl). FRANCE: generally distributed in the south, local in the north. Brittany—Pont de l'Arche district, Voie Blanche, Vaudreuil, Deux-Amants, Fleury-sur-Andelle (Dupont), Rennes district, coast from Cancale to St. Malo, Monterfil (Oberthür), near Vannes, Ploërmel (Griffith), Lardy, Mantes, Chartres, Châteaudun Auvergne, near Thiers (Berce), Indre—Brenne (Martin), Gargilesse, Sologne, St. Florent, Mt. Dor, Le Lioran (Sand), Balsièges, Mende (Rowland-Brown), Mt. d'Eraines, Troarn, Amfréville, Condé-sur-Huisne (Moutiers), Aube—Les Riceys, Ervy (Jourdheuille), forest of Orleans (Lafitolle), Eure-et-Loire—Beville-le-Comte (Guenée), Saône-et-Loire—La Senetrière, Fontenailles (André), Maine-et-Loire (Delahaye), Dordogne—Queyssac (Tarel), Savoy—Chavoire, Grésy-sur-Aix, Bourg St. Maurice (Tutt), Val du Fier, Val du Chéran (Oberthür), Sarthe (Graslin), Vienne—Charroux (Oberthür), Haute-Garonne, Loire-Infér.—Nantes, Portnichet (Roy), Alpes-Maritimes — generally distributed (Powell), mountains north of Nice (Oberthür), Grasse (Nicholson), St. Martin-Vésubie (Rowland-Brown), Hyères (Sheldon), Ste. Maxime (Powell), Basses-Alpes—Digne (Rowland-Brown), Bouches-du-Rhône—St. Pons, Pyrenées-Orientales —Port-Vendres, Vernet-les-Bains (Oberthür), Gavarnie (Turner), St. Sauveur, Héas from 3000 ft.-5000 ft. (Bath), Basses-Pyrenees—between Gèdre and Luz (Rondou), Gironde dept. (Brown), Guéthary (Chapman). GREECE: Corfu (de la Garde), Mesolonghi (Fountaine), Crete—Suda Bay (Fletcher), Canea (Mathew), Acarnania, Parnassus, Naxos, Euboea, Syra, Tino, Kos — Stanchio, Patara (Rühl). GERMANY: Prussia—Kulm (Speiser), Pomerania—Garz-an-Oder (Triepke), Frankfort-an-Oder (Zeller), the Schwalbenbergen near Garz-Schrey, Grambow Moor (Hering), Mecklenburg—Ludwigslust (Schmidt), Hanover—Osnabrück, Hameln, Osterode, near Göttingen, common (Jordan), Brunswick—Wolfenbüttel (Heinemann), Quedlinburg (Jordan), Harz, in the lower valleys (Speyer), Rhine provinces—Trier, Boppard, Bingen (Stollwerck), Hesse-Nassau, etc. —Biebrich, Mombach, Dotzheim, Wiesbaden (Rössler), the Frankfurt Stadtwald, Mombach Wald (Koch), Cassel, Quelenberg, Lindenberg, Chausseeböschung (Borgmann), Waldeck, Lichtungen, near Arolsen, Wildungen, Rhoden, Rotenburg-an-Fulda (Jordan), Thuringia—near Erfurt, Gotha, Arnstadt, Martinroda, Elgersburg, Rudolstadt, Eisenberg (Krieghoff), Gotha, Seeberg, Boxberg, Lauchaer Holz, Thuringian Wald (Knapp), Willeroder Holz (Keferstein), near Weimar, Jena, Osterland (Speyer), Saxony—near Zeitz-an-Elster (Wilde), the Petersberg near Halle (Stange), Oranienbaum (Richter), near Cöthen (Gillmer), Mühlhausen, Treffurt, Wanfried, the Iberge near Heiligenstadt, etc. (Speyer), the Kyffhäuser, near Nordhausen (Jordan), Brandenburg—Buckau (Pfützner), Rüdersdorf (Dadd), near Kornbusch (Kretschmer), Frankfurt-an-Oder (Herrmann), Landsberg (Speyer),

Posen—Owinsk, Cybinathal, Neutomischel (Schultz), Meseritz (Zeller), Silesia—Near Brieg, Obernigk (Wocke), Sprottau district, Wachsdorf, near Mückendorf, Altkirch, Donabrunnen (Pfützner), near Elstra (Schütze), near Leipzig (Speyer), near Connewitz, near Möckern, Grimma (Ent. Ver. Faun.), Bavaria—Regensburg (Hoffmann), Erlangen (Speyer), Württemberg—Tübingen, Reutlingen (Seyffler), Baden—Lahr, Carlsruhe, Heidelberg (Reutti), on the Thurmberg (Gauckler), valleys of Ueberlingen, Basel, Durlach, Weinheim (Meess), Alsace—in the Vosges (Speyer), near Darmstadt (Glaser). Italy: Probably throughout Tuscany—environs of Florence, Leghorn, etc., common (Stefanelli), Piedmont—Courmayeur, between Pré St. Didier and Aosta, Chatillon (Tutt), Susa (Rowland-Brown), Apennines—near Boscolungo (Norris), Pistoiese Apennines (Verity), Roman Campagna (Caradja), Pompeii (Oberthür), Sicily—Taormina, Messina, Palermo (Fountaine), Syracuse (Zeller), Madonie, S. Martino, Monreale, Palermo (Struve), Corleone, Serace (Calberla), Naples, Catania (Zeller). Montenegro: Cattaro (Nicholl). Netherlands: very rare—Limburg, Valkenberg, Maastricht (Snellen). Roumania: mountain valleys (Mann), Dulcesti (Hormuzaki), Tulcea (Caradja), Banater—Grenzgebirge (Viertl). Spain: Valés, Bilbao (Seebold), Castile, Sierra de Bejar, San Sebastian, Avila, Cuenca (Chapman), Malaga (Rühl), Granada (Rambur), Gibraltar (Walker). Switzerland: generally very local and confined to very restricted areas (Wheeler)—Basle (Knecht), Zürich (Frey), Lägern-in-Baden (Snell), St. Blaise and district (Couleru), St. Gallen district (Täschler), Grisons—Tarasp (Killias), Weissenburg (Huguenin), Rhone Valley—several places in the Pfynwald, Sierre, Brig (Wheeler), Martigny, above Plan Cérisier, between Aigle and Sépey, Arpilles (Favre), Zermatt (Zeller-Dolder), foot of the Grand Salève (beyond Veyrier) (Tutt). Turkey: Gallipoli (Mathew).

## Subfamily: Urbicolinæ.

### Tribe: Urbicolidi.

There are two British representatives of this tribe in Britain, *viz.*, *Augiades sylvanus* and *Urbicola comma*. Their eggs are entirely different from those of the Thymelicids, and their larvæ are of more distinctly "skipper" build, the neck being more constricted, somewhat after the manner of the larvæ of the Hesperiids. The pupa, too, is markedly different, lacking the tapering nose-horn (with its attendant hooks) and the abdominal segments, though tapering, are not so slender as those of the Thymelicid pupa.

Barbut's action in 1781 (*Gen. Ins. Linn.*, p. 173) in citing *comma*, Linné, no. 256, as the typical example of *Urbicola*, constitutes this the typical section of the superfamily. He notes of the final Linnean subdivision of *Papilio:*

Plebeii.
*Rurales.*
Ruralis *example* P. P. R. betulæ, Linn. no. 220.
*Urbicolae.*
Urbicola *example* P. P. U. comma, Linn. no. 256.

Under the name *Augiadae*, the tribe was diagnosed by Hübner (*Verzeichniss*, p. 112) as:

The wings above yellow, spotted beneath with pale (white)—*Augiades crinisus*, Cram., 300. *A. arcalaus*, Cram., 391. *A. comma*, Linn., Syst. Pap. 256; Hübn., Pap. 479-481. *A. sylvanus*, Esp., Pap. 36, 1: Hübn., Pap. 482-484. *A. helirius*, Cram., 60. *A. euribates*, Cram.

The imagines are, in this tribe, much larger and of heavier build than those of the Thymelicids, the forewings more pointed towards the apex, owing to the rapid slope of the outer margin to the anal angle; the androconial patch is larger, the fold more open, and usually followed beneath by an area of erect scales. The general features of the tribe are given by Speyer (*Can. Entom.*, x., pp. 151-2) as follows:

Club of antennæ ovate or elongated, at the end more or less curved into a

much thinner, acute hooklet, which may be shorter or longer, but always shorter than the club itself. The length of the hooklet depends upon the number of antennal joints of which it consists (in the American *phylaeus*, Dru., it is represented by the single terminal joint which sets upon the thick end of the club in the form of a short spine). Palpi placed close to the front, at most extending a little beyond the eyes, the middle joint broad anteriorly, closely set with long, brush-like hair-scales; the apical joint conical, either short and thick, or moderately long and more slender, yet not so thin and subulate as in *Thymelicus*. Tibiæ unarmed in some species, but with spines in most, which are the stronger upon the middle tibiæ. Body robust, the abdomen as long as the head and thorax united. Wings relatively small, stiff, the anterior ones triangular, the posterior ones short, mostly produced at the inner angle, particularly in the male. The anterior wings generally have a stigma, but no costal fold. The tuft is absent from the tibiæ.

Speyer further diagnoses (*op. cit.*, p. 152) the characters of at least four groups belonging to this subfamily, which read as follows:—

A. Club of antenna thick, with a sharp apical hooklet. Vein 2 (*i.e.*, the first branch of the median) of the forewings originates much nearer to the base than to the hindmargin of the wings, and is almost twice as long as is the trunk of the median vein to its end. The ♂ stigma of the forewings in its normal position—Pamphila, Fab.—*comma*, L., *sylvanus*, Esp., *ochracea*, Brem.

B. The last fifth of the elongated club of the antenna slender and bent backwards, but rounded out at the end. Second vein as in A. ♂ without stigma—Goniloba, H.-S.—*alcides*, H.-S.

C. Antennæ as in A. Vein 2 originates at, or a little before, the middle of the wing, and is not, or only a little, longer than the trunk of the median. Stigma absent, or, when present, directed more towards the outer margin and reaching only to the first vein—[Parnara, Moore]—*mathias*, Fab., *zelleri*, Led., *nostrodamus*, Fab.

D. Club of the antenna more slender and more fusiform, with acute, but less sharply defined, apical hooklet. The second vein starts in the middle of the wing. Fringe light-coloured, spotted with darker colour at end of veins. ♂ without stigma—[Acromachus, Nicév.]—*inachus*, Mén.

Watson has since given a detailed synoptical key of the group (*Proc. Zool. Soc. Lond.*, 1893, pp. 91 *et seq.*), to which reference should be made. In this, a much more minute generic division with diagnostic characters is made, and detailed generic descriptions are added. The important separation of *comma* (which he places in *Erynnis*) and *sylvanus* (which he places in *Augiades*) (*op. cit.*, pp. 91-92) is to be carefully noted. These are the only representatives of the tribe in Britain.

## Genus: Augiades, Hübner.

Synonymy.—Genus: **Augiades,** Hb., "Verz.," p. 112 (1816); Stphs., "Illus. Haust.," iv., p. 405 (1834); "List," 1st ed., p. 23 (1850); 2nd ed., p. 21 (1856); Wats., "Proc. Zool. Soc. Lond.," p. 103 (1893); Kirby, "Handbook," etc., iii., p. 27 (1897); Grote, "Proc. Sth. Lond. Ent. Soc.," p. 59 (1897); Staud., "Cat.," 2nd ed., p. 93 (1901); Lamb., "Pap. Belg.," p. 277 (1902). **Papilio,** Poda, "Ins. Mus. Græc.," p. 79 (1761); Scop., "Ent. Carn.," p. 181 (1763); Schneid., "Sys. Besch. Eur. Schmett.," p. 273 (1785); Lewin, "Insects," p. 96, pl. xlvi., figs. 1-3 (1795); Don., "Brit. Ins.," p. 8, pl. 254, fig. 2 (1795); Hb., "Eur. Schmett.," pl. xcv., fig. 482 ♂, figs. 483-4 ♀ (1802); text p. 72 (*circ.* 1805); Ochs., "Die Schmett.," i., pt. 2, p. 226 (1808); Freyer, "Neu. Beit.," vii., pp. 80, 170, pl. 646, fig. 2, pl. 696, fig. 2 (1858). **[Papilio-Plebeius-] Urbicola,** Esp., "Schmett. Eur.," i., pl. xxxvi. (supp. xii.), fig. 1 (♀) (1777), p. 343 (♀) (1779); Goeze, "Ent. Beit.," ii., pt. 3, p. 117 (1780); Bergs., "Nomenclatur," etc., p. 37 pl. lxxxix., fig. 435 (copy of Esper's fig.) (1780); Fab., "Mant.," ii., p. 84 (1787); Bork., "Sys. Besch.," i., pp. 180, 285 (1788), ii., p. 236 (1789); Haw., "Lep. Brit.," p. 50 (1803). **[Hesperia-] Urbicola,** Fab., "Ent. Syst.," iii., pt. 1, p. 326 (1783). **Hesperia,** Latr., "Consid. Gen.," p. 208 (1810); Leach, "Edin. Encycl.," ix., p. 130 (1815); Ochs., "Die Schmett.," iv., p. 34 (1816); Dalm., "Vet. Ak. Handl.," xxxvi., p. 201 (1816); Latr., "Eur. Meth.," p. 770 (1819); Sam., "Ent. Comp.," p. 242 (1819); Godt., "Hist. Nat.," i., pl. xii. *sec.*, fig. 2; pl. xii. *tert.*, fig. 3 (1821); Bdv., "Eur. Lep. Ind. Meth.," p. 27 (1829); Meig., "Eur.

Schmett.," p. 67, pl. lvi., figs. 3*a-c* (1830); Treits., "Die Schmett.," x., p. 248 (1834); Bdv., "Gen. et Ind. Meth.," p. 35 (1840); Dup., "Cat. Meth.," p. 35 (1840); Evers., "Faun. Volg.-Ural.," p. 87 (1844); H.-Sch.. "Sys. Bearb.," p. 159 (1846); Led., "Verh. zool.-bot. Gesel.," ii., p. 26 (1852); Speyer, "Geog. Verb.," p. 286 (1858); Hein., "Schmett. Deutsch.," p. 117 (1859); Staud., "Cat.," 1st ed., p. 15 (1861); Wallgrn., "Skand. Dagf.," p. 262 (1853); Newm., "Brit. Butts.," p. 171 (1869); Snell., "De Vlinders," etc., p. 86 (1867); Nolck., "Lep. Fn. Estl.," p. 83 (1868); Staud., "Cat.," 2nd ed., p. 35 (1871); Mill., "Cat. Lep. Alp.-Mar.," p. 116 (1872); Curò, "Bull. Soc. Ent. Ital.," vi., p. 216 (1874); Frey, "Lep. Schweiz," p. 55 (1880); Lang, "Butts. Eur.," p. 352, pl. 82, fig. 1 (1884); Kane, "Eur. Butts.," p. 147 (1885); Auriv., "Nord. Fjär.," p. 39, pl. vii., fig. 13 (1889); Dale, "Brit. Butts.," p. 213 (1890); Barr., "Lep. Brit. Isl.," p. 289, pl. xxxix., figs. 1-1*d* (1893). **Pamphila,** Oken, "Lehrb. Zool.," iii., pt. 1, p. 759 (1815); Stephs., "Illus. Brit. Ent.," p. 101 (1828); "Ins. Cat.," p. 28 (1829); Wood, "Ind. Ent.," p. 9, fig. 80 (1839); Humph. and Westd., "Brit. Butts.," p. 127, pl. xl., figs. 4-6 (1841); Dbldy., "Syn. List," p. 2 (1850); Westd. and Hewits., "Gen. Diurn. Lep.," p. 522 (1852); Sta., "Man.," i., p. 69 (1857); Kirby, "Eur. Butts.," p. 123 (1862); Butl., "Cat. Diurn. Lep.," p. 277 (1869); Kirby, "Syn. Cat.," p. 602 (1871); "Eur. Butts.," p. 65 (1882); Buckler, "Larvæ," etc., i., pp. 141-196, pl. xvii., fig. 4 (1886); Rühl, "Pal. Gross-Schmett.," pp. 643, 828 (1895); Meyr., "Handbk.," p. 359 (1895); Tutt, "Brit. Butts.," p. 126 (1896). **Heteropterus,** Ramb., "Faun. And.," p. 307 (1839); "Cat. Lep. And.," p. 88 (1858). **Erynnis**, Wats., "Proc. Zool. Soc. Lond,," p. 103 (1893).

The genus *Augiades* contains only one British species, *sylvanus*, Esp. It is extremely closely allied to *Urbicola*, of which also we have one British species, *comma*, L. Hübner described (*Verzeichniss*, p. 112) the coitus comprising this genus as follows:—

Die Flügel oben gelb, unten weiss gewürfelt—*Augiades crinisus*, Cram., *arcalaus*, Cram., *comma*, Linn., *sylvanus*, Esp., *helirius*, Cram., *euribates*, Cram.

The genus was diagnosed later by Watson (*Proc. Zool. Soc. Lond.*, 1893, p. 103) who separated it from the genus *Urbicola* (called by this author, *Erynnis*) as follows:—

Antennæ with club robust, elongate, terminal crook short. Palpi: second joint laxly scaled, third joint short, obtusely conical. Forewing: inner margin slightly longer than outer margin, cell less than two-thirds the length of costa, vein 5 from close to bottom of cell, vein 3 immediately before the end of cell, vein 2 in male considerably, in female slightly, nearer to base of wing than to end of cell. Hindwing: Vein 7 well before the end of cell, discocellulars faint, vein 5 not traceable, vein 3 immediately before the end of cell, many times farther from 2 than from 4, vein 2 considerably nearer to end of cell than to base of wing. Hind tibiæ with a long fringe and with two pairs of spurs. Male with a linear discal stigma on forewing, extending from origin of vein 3 to as far as vein 1—*Augiades sylvanus*, Esp., *herculea*, Butl., *venata*, Brem.

### AUGIADES SYLVANUS,* Esp.

SYNONYMY.—Species: *Sylvanus*, Esp., "Schmett. Eur.," i., pl. xxxvi. (supp. xii.), fig. 1, ♀ (1777); p. 343, ♀ (1779); Schneid., "Sys. Besch. Eur. Schmett.," p. 273 (1785); Fab., "Mant.," p. 84 (1787); Bork., "Sys. Besch.," i., pp. 180, 285 (1788); ii., p. 236 (1789); Fab., "Ent. Sys.," iii., p. 326 (1793); Lewin, "Insects," etc., p. 96, pl. xlvi., figs. 1-3 (1795); Don., "Brit. Ins.," pl. 254, fig. 2, p. 8 (1799); Hb., "Eur. Schmett.," pl. xcv., figs. 482 ♂, 483-4 ♀ (1802); text p. 72 (*circ.* 1805); Haw., "Lep. Brit.," p. 50 (1803) [and all other references under the generic name *Augiades* (*anteà*, pp. 131-2) except those mentioned below, are referable to *sylvanus*]. [? *Sylvestris*, Poda, "Ins. Mus. Graec.," p. 79 (1761).] *Comma*, Scopoli, "Ent. Carn.," p. 181 (1763). *Silvanus*, Bergstr., "Nomenclatur," etc., pl. lxxxix., fig. 435 (copied from Esper), p. 37 (1780). *Melicerta*, Bergstr., "Nomenclatur," etc., pl. xc., figs. 1-4, p. 38 (1780); Bork., "Sys. Besch.," i., pp. 180, 285 (1788).

ORIGINAL DESCRIPTION.*—*Papilio, Plebeius, Urbicola sylvanus.*—Alis

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* There is little doubt in our mind that this species is the *sylvestris* of Poda (1761), as, indeed, Scopoli appears to have known in 1763. The description of Poda's *sylvestris* is as follows: "*P.P. sylvestris.* Alis integerrimis flavis limbo

integerrimis divaricatis maculis utrinque pallidioribus (mas linea nigra). There are three butterflies very similar to each other, and the species here described has been hitherto considered a variety of *P. comma*, but it is distinct, and the individuals only pair *inter se*. The markings are constant, yet no one has noticed their specific distinctness. The larva is unknown. *P. sylvanus* is at once noticeable for its size; it frequently approaches *P. comma* in this particular, but is always slightly larger. The figure represents a ♀, the ♂ is distinguished by a black stripe on the forewings. From *P. comma* it is noticeably different, in that in both sexes the spots are almost of the ground-colour—rather paler and inclining to yellow—and on the underside hardly discernible, where in *P. comma*, the spots are white, sharply edged, and never like those of *P. sylvanus*. Close comparison makes the distinction more apparent. There are very few places in France where it occurs, but in its haunts it is rather plentiful. It is met with most frequently in July in sparse woods, and acting on the precedent of naming butterflies after those of the gods of the woods they frequent, I have named this species "*sylvanus*" (Esper).

Imago.—Expanse 27mm.-34mm. All the wings of a rich fulvous-brown, the outer margin of forewings broadly fuscous; a transverse row of paler angulated spots beyond the middle of the forewing, and a similarly tinted blotch extending from centre to base; the hindwings with a central transverse row of similar spots, and a separate one towards base. The underside paler, the spots of the upperside more or less distinctly marked in a tint varying from bright yellowish to whitish-ochreous.

Sexual dimorphism.—The sexual variation is very marked, the ♂ having a conspicuous, black, androconial pocket, extending obliquely towards the base from the centre of the wing (below the median nervure) towards, and nearly reaching, the inner margin. The androconia or scent-scales are, in this species, particularly specialised. The ♀ is also usually larger than the ♂, and the paler spots are more distinctly marked. "Two important differences are to be observed in comparing the androconial patch of this species with that of *U. comma*: (1) The large silvery covering-scales are entirely wanting in this species, in consequence of which the patch makes a more connected whole and its divisions stand out less sharply. (2) Among the jointed androconial scales there are some unjointed ones (fig. 20). The former scales reach to 0·5mm. in length; sometimes only a part of them is jointed, the other part unjointed. Thus they appear in

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fuscescente; primoribus supra linea transversa lanceolata nigra. Habitat in sylvis. [Between *menalcas* and *amyntas*.]" (Poda, *Ins. Mus. Graec.*, p. 79). This species is also undoubtedly Scopoli's *comma*, which he queries particularly as being not Linné's *comma*, and then describes as: "Long. lin. 6½, lat. 3⅓. (*Sylvestris*, Poda, *Mus. Graec.*). Alæ concolores corticinæ; limbo fusco. Caput crassum; antennis unco terminatis. In sylvestribus. Noster caret maculis pallidis albidisque, cæterum idem cum Linnæano, juxta descriptionem datam in *Fauna Suecica*. Sexus unus habet lineam nigram obliquam in medio paginæ superioris alæ anticæ cuiusque; alter caret hac linea et pallidior est. Uterque sedens, gerit alas suberectas" (*Ent. Carn.*, p. 181). Werneburg notes that Ochsenheimer gives *sylvestris* as doubtfully *comma*, but in his opinion it is certainly *comma*, because only in *comma*, and not in *linea* (*flava*), could the black dash of the forewing be called "linea lanceolata." Werneburg had evidently overlooked Scopoli's *comma* and Esper's *sylvanus*, and it appears to be not at all possible that Poda would, had he had *comma* before him, left out such a marked character as the white spots on the underside.

general less developed than those of *U. comma*, and by comparing these species one finds that such an unimportant colour-character as a very short silver stripe, may yet constitute a very great and important morphological difference. The tuft of hairs is wanting on the hind tibiæ" (Aurivillius).

VARIATION.—Viewed from a British, and even from an European, standpoint, one would say that this species was particularly constant in size and markings. For all that, however, there is some variation in tint of ground-colour, in the conspicuousness (or the reverse) of the paler markings, in the extent to which they occupy the basal half of the wings, and in size. On the underside, too, there is considerable variation both of fore- and hindwings, in tint and markings, and here the normal pale spots may be very conspicuous, obsolete, or united into a distinct curved, almost V-shaped, band. Esper figures a ♀ [*Schmett. Eur.*, pl. xxxvi. (supp. xii.), fig. 1] that has the spotting of the underside of so pale a tint as to make it resemble that of *U. comma*. But it is in size that the greatest variation exists, and one finds as a rule that the specimens become larger as one goes south and east, *e.g.*, Sicily, Syria, Japan, etc., developing in the east so greatly in this direction that, at least, two forms have been described as distinct species. Wheeler states that the specimens from the mountains of central Europe are generally darker than those from the plains. Occasional aberrations have been recorded by various collectors, *e.g.*, Buckstone notes a ♂ with a patch of pale yellow on the forewings between the costa and the oblique discal mark, taken at Purley, in July, 1896; he also records a smaller and darker ♀ than usual from Dorking, taken in 1898 (*Proc. Sth. Lond. Ent. Soc.*, 1899, p. 109). Hormuzaki took (*Verh. zool.-bot. Gesell.*, l., p. 28) a very dark ♀ at Gastein, and described two other ♀s, both only 29mm. in expanse, ground-colour intense dark brown, spots unusually small and distinct = ab. *obscura*, n. ab. (*op. cit.*, xlvii., p. 167). Henning found a melanic specimen at Frischingwald in Prussia (*teste* Speiser), and Oberthür notes (*in litt.*) an aberration from Vernet, in which the underside of the hindwings has the disc pale, owing to the confluence of all the small spots into a single one = ab. *juncta*, n. ab. He has also another aberration, a ♂ taken in England, the hindwings of which are very pale without markings. It is difficult to classify the aberrations with which one occasionally meets in Britain and on the continent of Europe where the more typical form occurs. These appear to be—

(1) The ground colour pallid, the scaling poor, the normally darker areas tending to albinism, and the spots more bleached than usual, giving an impression of pallid uniform colouring = ab. *paupera*, n. ab.

(2) Uniform fulvous-brown to outer marginal areas which are darker; the usual pale spots almost or quite obsolete = ab. *obsoleta*, n. ab.

(3) Bright fulvous-brown from base to outer marginal area, pale spots almost of same colour; marginal area of rather deeper brown, but not contrasting with spots or median area = *sylvanus*, Esper.

(4) The pale spots contrasting strongly with the ground colour which is strongly mixed with fulvous, the darker tint conspicuously present in basal as well as marginal areas. The underside usually fairly marked with upperside design = ab. *opposita*, n. ab.

(5) The ground colour as in the former, but rather brighter, the marginal areas particularly dark; the forewings with a narrow marginal black line, the hindwings more broadly black-margined; the pale spots full-coloured, bright, but contrasting with ground colour. The underside particularly clearly marked with the upperside design = ab. *clara*, n. ab.

(6) The pale spots of fore- and hindwings united with discal spots and continued to base as a pale blotch, leaving a dark outer margin = ab. *extensa*, n. ab.

In the ab. *obsoleta* the ground colour encroaches on and drives out the pale spots, in ab. *extensa* the pale spots encroach on and expel the ground colour. Of the races that deserve notice or have been described, we note the following:

*a*. var. *norvegica*, n. var.—Of small size, 28mm. In the ♂ the forewings with whole area from base to angulated line bright tawny, except a small patch at upper end of androconial streak (*i.e.*, like ab. *extensa*); the outer margin fuscous; the hindwings bright, inclining to tawny, with transverse row of still brighter spots, a narrow black marginal line and blackish costa. The ♀ more fuscous; the paler marks of forewings restricted to angulated line and outer edge of discal cell, and on the forewings to the four usual transverse dots. The ochreous underside brighter, also the paler spots consequently not conspicuous, the basal part of hindwings dusted with greenish scales; the rest typical (Saeterstoen. Taken by Chapman, June 27th-July 2nd, 1898).

This is a small form of good colour.

*β*. var. (et ab.) *anatolica*, Plötz, "Stett. Ent. Zeit.," p. 219 (1883); Rühl, "Pal. Gross-Schmett.," i., p. 828 (1895); Staud., "Cat.," 3rd ed., p. 93 (1901).—♂ 16mm. Upperside of the forewings red-yellow, bordered with brown; cells 1, 2, 4 and 5 spotted with brown; in the middle cell rust-coloured lines. The underside of the forewings black on the hind margin near the base. Hindwings brown with red-yellow basal spot, and a row of spots beyond the middle; underside of hindwings green, more or less mixed with rusty-yellow; red-yellow prevailing towards the anal angle; the yellow spots often very indistinct. Asia Minor (Plötz).

The main feature of this variety is the green coloration of the underside of the hindwings. We have seen no approach to this among the specimens we have collected. Staudinger notes it from Asia Minor and Southern Italy.

*γ*. var. *hyrcana*, Christ., "Iris," vi., p. 87 (1893); Rühl. "Pal. Gross-Schmett.," i., p. 643 (1895); Staud., "Cat.," 3rd ed., p. 93 (1901).—Inter *Hesperias venatam*, Brem., et *sylvanum*, Esp., ponenda. A *venata*, Brem., differt: Alis anticis apice minus acuto, posticis minus latis, colore satiatiori fusco-ochracea linea, disci crassa obliqua fusca (non nigra), fasciis, macularum media et terminali lata, fuscis ♀ eadem colore, quam in ♂ re fasciisque angustioribus dilutioribus fuscis. A *sylvano* differt: magnitudine, fasciis distinctioribus, obscurioribus colore paullum dilutiori. Long. alæ, ant. 17mm. Lenkoran, Astrabad. Hyrcaniæ (Christoph).

Staudinger notes the form as being, in ♂ and ♀, above "Obscurius marginata et maculata."

*δ*. var. (et ab.) *venata*, Brem., "Et. Motsch.," p. 61 (1852); Brem. and Grey, "Beit. zur Schmett.," p. 11, pl. iii., fig. 5 (1853); Mén., "En.," i., pl. v., fig. 8 (1855); Fixs., "Rom. Mém.," iii., p. 315, pl. xiv., fig. 5 (1892); Staud., "Rom. Mém.," vi., p. 212 (1887); Rühl, "Pal. Gross-Schmett.," i., pp. 643, 828 (1895); Staud., "Cat.," 3rd ed., p. 93 (1901). *Herculea*, Butl., "Ann. Mag. Nat. Hist.," 5th ser., vii., p. 140 (1881).—*Hesperia*. Alis supra: fulvo-ochraceis, nigro-marginatis et venatis, apice non nihil obscuriori, linea discoidali nigra; subtus: omnibus fulvo-ochraceis, anticis basi nigra. Expans. alar. antic. unc. 1½ (Bremer). Amur, Altai, etc. (Staudinger). Isle Askold (Jankowski), Corea—Séoul (Kalinowalski), China—Leon-Tang (Mouton).

Oberthür says (*in litt.*) that, in his opinion, *venata* is a geographical race of *sylvanus*. According to Staudinger this form, in the ♂, has the upperside not dark-margined, and the underside almost unspotted. He combines *venata*, Bremer, with *herculea*, Butler, who described the form as a distinct species as follows: "Allied to *sylvanus*, considerably larger, ♂ of a clearer, more ochreous, colour above, and on the undersurface of a more uniformly tawny colour; the secondaries not yellowish, as in *P. sylvanus*; pattern similar. Expanse of wings 1 inch 7 lines. ♀, above bronzy-brown or chocolate-brown, with cupreous reflections; primaries with a yellow dot just above the basal third of submedian vein, a cuneiform spot filling the base of the first

median interspace; a bifid spot at the end of the cell; a series of five quadrate spots, excised in front, crossing the disc obliquely from submedian to upper radial vein, and a trifid spot across the subcostal branches, half-way between the cell and the apex, buff; secondaries with angular discal series of five ochreous spots. Wings, below with the markings paler than above, the spots creamy-whitish or pale bone-yellow; disk of primaries round the borders of the oblique series of spots olive-brown; external angle and outer border whity-brown; secondaries bronzy olive-brown, the discal series consisting of six spots, anal angle broadly ochreous, outer border tinted with ochreous; palpi white; body below bluish-grey. Expanse of wings 1 inch 7½ lines."

ε. var. *tochrana* [Brem.], Rühl, "Pal. Gross-Schmett.," p. 643 (1895); Tutt, "Brit. Butts.," p. 126 (1896).—Imago 32mm.-35mm. This is also a large form, which actually forms a transition to *subhyalina*, but nevertheless comes nearer to *sylvanus* than to the other species. Upperside almost as bright brownish-red as in the typical form, but the outer margins are generally more strongly darkened. The arrangement of the spots as in *sylvanus*, and not so pale and vitreous as in *subhyalina*. Underside of a very deep reddish-yellow, almost cinnamon-brown, with sharply defined dark nervures. Locality—Hakodate, June-July (Rühl).

ζ. var. (an spec. dist.) *faunus*, Turati, "Il Nat. Sic.," xviii., pp. 36-37; pl. vi., figs. 5, 9; vii., fig. 3 (1905).—Fulvo-ochracea; fascia externa brunnea distincta, ad apicem angustiore quam in *sylvano*. Antennis tenuioribus unicoloribus fuscis; clava subtus fulva (Turati).

This is described as a distinct species, but we are not able to distinguish between the figures of this form and our ab. *extensa*. One ♂ only was captured, at Gavarnie, July, 1894; it is 28mm. in expanse; ground colour rather deeper than that of *sylvanus*, less brown than *comma;* dark brown outer marginal band rather narrower than in *sylvanus*, &c. The hindwings with an almost uniformly wide marginal band; otherwise as in *sylvanus*. On the underside of the forewings the pattern is more distinct than is usual in *sylvanus;* the hindwings have the interneural spaces marked with elongate pale yellowish spots, instead of the ordinary pattern of *sylvanus* (Turati).

Egglaying.—On August 8th, 1905, at Bourg St. Maurice, on a flowery bank, where *Adopaea thaumas*, *A. lineola*, *Thymelicus acteon*, *Urbicola comma* and *Augiades sylvanus* were all occurring together, I observed a ♀ *sylvanus* in the act of egglaying. Standing lengthwise on the front of a grass-leaf, she very carefully turned her abdomen around the left edge of the leaf, and felt for a moment before withdrawing it; she then hurriedly darted off, returning, however, almost immediately to the same leaf, settling near the top, and sliding quickly down to the same point as before, and going through a similar series of movements as on the first occasion, again flying away quickly not to return. I fully expected to find two eggs on the back of the leaf, but there was only one, which, I think, she must have laid on the first occasion; it was just round the left edge of the leaf (from the point of view of the insect facing the front surface) and laid as an ordinary upright egg (Tutt). In July, 1868, a ♀ was observed flying from one stem of grass to another several times, as if particular in selecting, and, having found a suitable one, slid gently, but quickly, down it, apparently by means of the legs; when she was gone the sheath formed by the leaf round the upper part of the stem was examined, and about thirty small white eggs deposited in a line found therein (Ullyett). A ♀ was observed to lay three eggs side by side on the undersurface of a grass blade, July 17th, 1897, and others on June

27th, 1905 (Raynor). A ♀ was observed to deposit an egg on the underside of a blade of *Brachypodium sylvaticum*, July 24th, 1904, at Lausanne, the larva appeared in eight days. On the afternoon of July 22nd, 1905, I again witnessed a ♀ deposit an egg on the underside of a blade of grass, that was probably *Molinia caerulea*, another egg was subsequently found in a similar situation. Both these ova hatched on July 30th, one of them certainly (and probably both) having been only eight days in the egg stage (Sich). In confinement, the eggs are laid openly and singly (Hellins). In the Harwich district, Mathew has often seen the females laying their eggs on *Dactylis glomerata* and other coarse grasses.

Ovum.—The egg is a little more than a hemisphere, the convex side being apparently a portion of a sphere, the attached side plane. Diameter 0·96mm., height 0·54mm. The colour is creamy-yellow with a slight greenish tinge, getting rather orange towards maturity. The sculpture is an irregular network, for the most part hexagonal, the cells about 0·025mm. in diameter; the lines separating them very fine and narrow. Each cell is marked with 20 to 30 small dots arranged in some degree in lines, whether these dots are thickening, or thinnesses, or alterations in texture does not appear. In the arrangement of the cells one important point appeared, *viz.*, that though the cells are irregular and quasi-hexagonal over the top, near the base they are arranged in vertical rows and differed only from the ordinary arrangement of vertical (primary) and transverse (secondary) ribs, in that the vertical ribs are not more marked than the transverse, and that neither affect the form of the egg; they are also very numerous, the vertical ribs about 100 or rather over. The vertical ribs zigzag as is frequent, *i.e.*, the transverse ribs alternate in adjacent rows, they are closer together than the vertical ones. The micropyle is surrounded by an irregular rosette of eleven cells, each very narrow, but about half as long as the others, they are followed by others rather longer, but it is not till seven or eight rows (or circles) of cells outwards that a distinct narrowing, making them radiants from the micropyle, fails to be evident (Chapman. July 1st, 1901). The upright egg would have been spherical but was much flattened at base. Under a lens the micropyle appeared as a slight depression on the summit of the egg, with a minute raised point in the centre. The general surface under a low power appears smooth with lines running irregularly in all directions over it like veins in marble. The surface-sculpture really consists of a raised network enclosing polygonal cells, with small raised bosses at some of the angles, these cells become more elongated as they approach the micropyle. The micropylar rosette consists of a dozen very elongated cells with the outer ends rounded. When first laid, the colour of the ovum was grey, but in some lights it looked green from the reflection of the leaf on which it was laid. Its diameter 1·03mm., height 0·7mm. Very little change took place in the colour, but on the sixth day a black spot appeared in the centre, and two days later the larva appeared, the egg stage having only lasted eight days (Sich, July 24th, 1904, and July 22nd, 1905). Other descriptions are to be found (1) By Hellins, *Buckler's Larvae*, etc., i., p. 196 (1886). (2) By Tutt, *Ent. Record*, etc., x., p. 15 (1898). Tonge notes of the eggs figured in our pl. i., *viz.*, fig. 4 from Maldon, and fig. 3 from Bourg St. Maurice, that the former has its greatest diameter 1·01mm., the latter 1·20mm.

Habits of larva.—The newly-hatched larva devours a portion of

the eggshell, sometimes all except the base. The egg stage as determined by Sich (in Lausanne and England) lasted eight days, but Hellins notes it as thirteen days, so that there may be some difference in this respect. The young larvæ will feed on various grasses in confinement, *Poa annua*, etc. Hellins observes that, as soon as some larvæ he had in confinement had devoured the eggshell, they took up a position of rest in the middle of a blade of cock's-foot grass, fastening its edges across with five or six distinct little ropes of white silk. They soon, however, spun together the edges of the grass blades, and made an opaque web, not much bigger than themselves, for hiding-places, and, at the end of October, spun long, close-fitting, narrow, tough, silken hibernacula (Hellins). The hybernating tube is very like, if not identical with, the feeding-tube, differing in having a strong grass stem as one of its elements, which is rarely the case when the larva is younger, although one hybernating individual now has only a very weak one; it also differs in that the leaves are now nearly all brown and dead, although there are still green blades on the plant. The larva gets somewhat shorter, thicker, and more sluggish after a few weeks and is of a more transparent vivid green (having apparently no material in the alimentary canal) than when feeding (Chapman. October 12th, 1905). In early spring the larvæ recommence feeding. In confinement, if disturbed, the larva coils in a close ring, the head against the anal prolegs, the anal flap extending over both as a shield. Its movements are extremely sluggish, and it crawls exceedingly slowly from one point to another (Tutt). The larvæ are fullfed in May, each one spinning then a silken lining in a cylinder previously formed by uniting the edges of a leaf of grass or *Luzula*, and in this it changes to a pupa. When fullfed the larvæ move somewhat slowly and appear to be much more lethargic than those of *U. comma* (Hellins).

Larva.—*First instar* (newly-hatched): 3·5mm. long, yellow-grey; head large, black, polished and smooth, with a few short scattered hairs. Prothorax with a black plate and another small square one between it and spiracle (which is larger); this extra plate has a convex boss (lenticle?) and one hair; on the plate are five hairs on each side; in front of the spiracle are two hairs. On the 2nd and 3rd thoracic segments are two convex brown plates (lenticles) in front of iii. The abdominal subsegmentation is into seven, in size 2·5:1:1:1:1:1:1. The 2nd and 3rd thoracics have five hairs almost exactly in a transverse line, and apparently representing tubercles i, ii, iii, iv, vii. The abdominal hairs are i on 1st subsegment, ii on 4th, and iii on a slight elevation above spiracle and just below where subsegmental incisions end. Of iv and v, the anterior (v) is below spiracle and slightly in front, the posterior (iv) well behind spiracle and at an elevation half-way between spiracle and the front hair; one lower than this is not clearly determined; on the 8th abdominal the spiracle is very large and well above (and behind) iii; hairs representing iv, v and vii (?) are distinct. On the 10th abdominal are four very long hairs 0·3mm., and four shorter 0·1mm., as compared with 0·05mm., the average length of the other hairs of the ordinary tubercles. The prolegs have a complete circle of about 35 equal hooklets. There is an anal comb of seven or nine tines. The claspers want the outer posterior fourth (Chapman, July 9th, 1905). *First instar* (two days old): Head black, pitted; thoracic plate black. The tubercles simple, each bearing one clubbed seta. No secondary setæ or hairs. The meso- and meta-

## Plate XX.

*(To be bound facing Plate XX.)*

### Augiades sylvanus.

Fig. 3.—Larva of *Augiades sylvanus* (penultimate instar, March 25th, 1906) ×2.

Fig. 1.—Larva (in last instar, May 20th, 1906) ×1.

Fig. 2.—Larva (in new house, June 14th, 1906) ×1.

### Nisoniades tages.

Fig. 6.—Hybernating larva of *Nisoniades tages* ×2.

Fig. 4.—Pupa of *Nisoniades tages* (♀) ×2.

Figs. 5-7.— ,, ,, ,, (♂) ×2.

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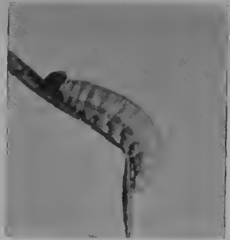

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LARVA OF AUGIADES SYLVANUS. LARVA AND PUPA OF NISONIADES TAGES. *Photo. Hugh Main.*

*Natural History of British Butterflies*, Dec., 1906.

thorax have each two (black bordered ?) lenticles, one on each side of the mediodorsal line, just above and in front of tubercle iii. I saw no other lenticles on the larva. The prothoracic spiracle and that on the 8th abdominal large, the others small and much raised (August 1st, 1905). [A week later I again took these larvæ out of their tubes of grass, and found that they were both in the second instar.] *Second instar:* Head black, pitted, with numerous simple hairs. The prothoracic shield black, narrow, with a transverse groove, as though it were situated on two subsegments. Below the shield is a triangular black patch enclosing two brown lenticles. The prothorax apparently divided into eight subsegments. The 6th subsegment carries two lenticles; the mesothorax has four subsegments, with two lenticles on the 3rd subsegment; the metathorax with six subsegments, the first large, while the second carries two lenticles. Normal abdominal segments apparently divided into six subsegments, the first of which is large and carries a lenticle on the dorsum, the second bears a lenticle above and in front of the spiracle which is situated on the 3rd subsegment. Below the spiracle on the flange is a third lenticle. The 10th abdominal segment is very peculiar, being pale-brown in colour and covered with a network of darker lines. At first glance the green larva looks as if it had a head at each end. The whole larval skin is covered with small black spicules and also with small black warts, each with one black hair. These warts, however, are arranged in a transverse row along the ridge of each subsegment. The chin-gland is conspicuous just in front of the prothoracic legs. The primary tubercles could not be made out in this instar, which, as will be seen, even from these very meagre descriptions, is entirely different from the first instar [Sich, August 8th, 1905]. *? Third instar* (three weeks old): 12mm. in length; colour now dull green; head and thin curved prothoracic collar shining black (Buckler, August 13th, 1876). *? Fourth instar* (hybernating): 13mm. in length; shorter, thicker, and more sluggish than when feeding; also of a more transparent vivid green (apparently no material in alimentary canal), being of a bright grass-green but slightly autumn-tinted at the anal plate. The head nearly black, with a broad brown streak on each side of the face on front view; this streak triangular in so far that it narrows nearly to a point at the vertex, but here, as well as at its other margin, it is not sharply defined, but shades into the dark part of the head; it might almost be said that the whole front is brown, as, though there is black medially, it is broken up further by a brown line beside the clypeus and a brown centre to the clypeus. The head is finely but deeply wrinkled or pitted, with very fine, nearly white, hairs, arising usually from the bottoms of the pits. Viewed laterally, the larva lies flat on the surface in front, but medially and posteriorly is raised on the very short, broad bases of the prolegs. The head is 2mm. high, the neck 1·5mm., the back then slopes up to 2mm. at 2nd abdominal, hardly falling again to 7th abdominal, whence it rapidly slopes to the anus, which projects nearly 0·5mm. beyond the claspers, so that one looks (from the sides) under it, just as one does under the spaces between the prolegs. The green surface is closely studded with black points, not so closely as to make the larva look dark, but so much so as to give the actually bright green of the skin a slightly dingy hue, when the larva is examined without a lens. There is a distinctly darker dorsal line, and a faintly darker shade about half-way between dorsum and spiracles. There is a fine whitish line running through the small

brown spiracles; this is almost certainly the lateral tracheal trunk showing through the skin and subjacent green fluid. The waved flange below this, in some lights, or, perhaps, rather at some angles, looks definitely paler; this is when one looks through its margin rather than into the depths of the larval structure. This appearance is more noticeable on the prothorax and on the last segment, where there seems to be a really lighter tint, or the light passing through it is affected by the differently tinted head and anal plate. The prothorax has a central transverse incision, the portion in front of this is convex and freer from skin-points, but carries one row of hairs. The brown spiracles, laterally, are very large, three or four times the diameter of the abdominal ones, except the last, which is again very large, but smaller than the prothoracic; it is a very distinct terra-cotta brown spot, visible without a lens, and is much more dorsal than the others; all the spiracles stand up at the summit of brown chitinous tubes, like tailors' thimbles. The black points already alluded to are not skin-points, but hairs; each is a small round black button with a minute hair at top. They are about six or seven times their diameters apart, the distance apart being about 0·06mm., and their diameters about 0·01mm. The true skin-points are colourless, or nearly so, and present six or eight between any two of the hair-points. The subsegmentation (dorsally) of the abdominal segments is into seven portions, of which the first is nearly as wide as three of the others, the others about equal, but the last narrowest; from front to back of the largest (front) one, there may be perhaps eleven, of the others three, hair-points, but as their alignment is rather oblique when there is any, this is more of an estimate than correct counting. On the 2nd and 3rd thoracic segments there are three subsegments, of which the middle one is very wide laterally, very narrow dorsally, the other two disappear below laterally but are wider dorsally, with curved margins against the middle subsegment. The 1st abdominal seems to have fewer subsegments (the posterior small ones) than those following, but they may be sunk in the incision. At the spiracular level the subsegmentation is evanescent—each spiracle is a little in front of the middle of the segment, which is here rather prominent. A little way below the spiracles is the lateral flange, which almost hangs down like a curtain, and has a waved margin, varying a little with attitude, usually a small wave in front and a larger behind below the spiracle, but this one may be again divided; posteriorly the flange is rounded, less curtain-like, and less definitely divided. Below the lateral flange is another, half-way between the upper one and prolegs, sometimes very obvious, at others invisible, according to attitude. There are numerous lenticles; the most conspicuous are two about two-thirds down the anal plate. There are also two marks near the base of the plate which have, however, no lenticular structure. On the prothorax is one well below the spiracle, and one well below and behind the spiracle is on each abdominal segment (=iv ?). There is one above and in front of spiracle (=iii ?), and one on the 4th subsegment higher up (=ii ?). If these identifications mean anything, then tubercle i is unrepresented. On the 8th abdominal, iii is in front of, not above, the spiracle, the latter being so much raised. The 1st, 2nd, 7th, 8th and 9th abdominals have ventral lenticles apparently in place of prolegs; they are, however, on what corresponds with the segment just above proleg. On the 2nd and 3rd thoracic

segments are lenticles ranging with iii, and on each a pair ranges with ii, which on mesothorax are accompanied by a hair, the base of which much resembles a third lenticle. The lenticles are little black raised rings with clear centres, and are from 0·03mm. to 0·04mm. in diameter. The true legs are light brownish. The prolegs are complete circles, quite round, and 0·4mm. in diameter when expanded, the hooklets are in one row, but alternately large and small, and about sixty in number. At the inner posterior aspect for four or five hooklets there is, on one or two prolegs, a decided weakness of the hooklets, one or two being only horny points; on other prolegs the circle is quite complete. The claspers are larger but otherwise much the same, except that they are deficient along the posterior margin for about one-quarter of the total circumference (Chapman, October 12th, 1905). *? Same instar* (after hybernation): About 13mm. long when at rest, 15mm. when crawling. Head large; prothorax constricted; the body, from 1st-6th abdominals, almost cylindrical (although slightly wider at 1st abdominal), thinning off rapidly to prothorax and anus. Colour of body dull green, except at the anal segment, which is brownish; skin covered with minute, shiny, black points, here and there also are scattered metallic-looking points. The subspiracular flange is paler, inclining to white; the skin-surface covered with a thick clothing of minute hairs; a slightly darker, mediodorsal, longitudinal line, and a rather paler subspiracular line. Head oval in outline from front, sloping upwards and backwards, exceedingly rough, brownish-black in colour, with more definitely black markings, and covered with short stiff bristles; the mouth-parts shiny black, the ocelli also shiny black and conspicuous. The prothorax narrow, apparently divided into three subsegments, the meso- and metathorax into four subsegments, the 1st and 2nd abdominals into five, and the 3rd to 7th abdominals into seven, subsegments, whilst the last segments are less distinctly subdivided, the 8th appearing to have almost three equal subsegments, the 9th undivided, whilst the 10th consists of a large anal flap that shows no segmentation; in the abdominal segments 1-7, the 1st subsegment is much wider than the others. The bases of the primary setæ appear to be traceable as rather larger black points than those so abundantly spread over the skin-surface, but it is difficult to locate them for certain. The spiracles are somewhat flesh-coloured, inclining to brown, those on the prothorax and 8th abdominal conspicuous, the others small and inconspicuous, and all placed just above the subspiracular flange. There is also a series of supraspiracular lenticles, almost exactly of the same colour as, but larger than, the spiracles, which might be connected with the supraspiracular tubercles, but do not seem to be so. The venter is flat, the skin much folded and wrinkled, the colour rather fuller green than the dorsum; the true legs paler greenish, glossy-looking, with a dark brown terminal hook, and rings of tiny, down-pointing hairs at the joints; the prolegs are of the same green hue as the venter, with bristles at the joints, which are large and well-marked; the terminal hooks also pale brown (Tutt, April 21st, 1905). *Final instar:* 25mm. in length, the figure, viewed from above, nearly even in width, tapering a little at prothorax and anal segment, but viewed sideways it tapers in a curve considerably from 4th to the terminal segment, which last is flattish, and forward again to prothorax, which is the smallest segment; the head is like a knob, but the lobes

are divided; the ventral surface is flat. Altogether the appearance is plump. The colour pale green, the skin thickly covered with very short dark brown bristles, the head dirty white, with dark brown stripe down the outer edge of each lobe; the neck whitish-green (Hellins). *Full-grown* (May 4th, 1882): Cylindrical above, flattish beneath: the body pale bluish-green, an indistinct dorsal line of darker green, and a paler line above the feet, which are small. The head large and singularly prominent, of a crimson-brown colour. The thoracic segments taper towards the head, giving it a strangulated appearance (Buckler, May, 1877).

Foodplants.—*Luzula pilosa* (Buckler), cock's-foot grass (*Dactylis glomerata*), couch grass (*Triticum repens*), garden riband grass (Hellins), *Poa annua* (Sich), *Avena pubescens*, *Holcus lanatus*, *Phalaris arundinacea* (Rühl), *Festuca duriuscula* and other coarse grasses (Boie).

Puparium.—The fullfed larva spins a silken lining in a cylinder previously formed by uniting the edges of a leaf of *Luzula*, in which pupation takes place (Buckler). A fullfed larva was found May 6th, 1871, in a slight enclosed shelter formed of a few blades of grass spun together, which proved to be its puparium, for the larva fixed itself head downwards, and in this position changed in a few days to a rather thick pupa about ·75 ins. in length. During the first week in June the pupa became darker and the imago emerged June 8th, 1871, at 1.15 p.m. (Watkins). A pupa found spun up in an ivy leaf in a hedge in Durham, from which imago emerged in due course (Harrison). There appears to be some variation in the length of the pupal stage, which Paul and Plötz state lasts only twelve days.

Pupa (dehisced).—Length 17mm.-18mm., width at 3rd abdominal segment (probably widest) 4·5mm. Unlike the pupa of *Hesperia malvae*, the free and following abdominal segments are tapered to the end by a curvature as much dorsal as ventral, and the 4th abdominal segment is of equal width dorsally and ventrally. The colour is very dark, probably when alive it was modified by an underlying green shade, but now it is deep greyish or brownish-fuscous on metathorax and abdomen, nearly black on rest of thorax and appendages. The maxilla-case stands quite free for 5mm. beyond the end of wings, and its extremity is little short of being level with the cremaster. Except the appendages the whole pupa is clothed with short reddish hairs. Being from an empty and no doubt disturbed case, the following measurements are only approximate but probably nearly correct, others are not given, as being unobtainable with any accuracy:—

| Length. | | Antero-posterior Diameter. | |
|---|---|---|---|
| To end of 1st leg | = 7·0mm. | At end of 4th abdominal segment | =4·0mm. |
| ,, ,, 2nd ,, | = 9·0 ,, | ,, ,, 5th ,, ,, | =3·7 ,, |
| ,, ,, wings | =11·5 ,, | ,, ,, 6th ,, ,, | =3·3 ,, |
| Base of cremastral spine | =17·0 ,, | ,, ,, 7th ,, ,, | =2·8 ,, |
| End of pupa | =18·0 ,, | ,, ,, 8th ,, ,, | =2·0 ,, |
| | | At base of cremastral pen | =0·3 ,, |

Beginning with a dorsal view, the head carries a number of reddish hairs about 0·3mm. long; the front outline is in three forward curves with hollow between. The dorsal headpiece remains attached to the prothorax, it is very small, 0·7mm. from middle line to outer angle

with the antero-posterior width least in middle line (about 0·1mm.), wider outside (about 0·15mm.); black, wrinkled in longitudinal lines, but with no hairs or other features, and (in the dehisced case) is continued outwards by a colourless streak which represents the covered portion of the piece, and, being broken off abruptly, no doubt was attached to the outer eyepiece, and possibly may occasionally so continue in the dehisced pupa, as this outer eyepiece separates from rest of head appendages. The prothorax is about 2mm. from middle line to outer margin, and 1·2mm. from back to front. It carries a few red hairs similar to those on head. On its anterior half it carries a peculiar set of organs, that may be called lenticles, and no doubt represent those on the thoracic plate of the larva. These are about twelve in number on either side, four near the middle line and eight further out, but not symmetrical, so there may probably be considerable variation in their position in different pupæ. These organs are slightly raised black circles with a brown tympanic membrane, quite translucent, and producing (in dehisced pupa) a very curious effect on the black plate from their translucency, looking very like the ocelli on the head of a cast larva-skin. The rest of the sculpturing of the prothorax is in very fine transverse waved lines. The same sculpturing obtains in the mesothorax, which carries also a good many short hairs 0·1mm.-0·15mm. long perhaps, reddish, looking a rather dense forest viewed laterally, but on dorsal view practically invisible. The wing-spine is a slight elevation, and an outline, as of the patagia, somewhat raised, is marked. The metathorax is narrow medially (0·7mm.), wider at outer margin (1·6mm.); at its anterior outer corner is a slightly raised dark spot. The sculpturing is still in minute waves, but these are here less regular in direction, there are a good many fine short hairs. The hindwing is marked off from the metathorax by something much more than usually like a suture, and the wing is darker than the rest of the segment, which approaches the paler tint of the abdomen. The surface of the hindwing and part of that of the forewing adjacent face more than usually dorsal. This is no doubt exaggerated in this specimen, being dehisced, but there is certainly a hollow angle between the hindwing and the 2nd and 3rd abdominal segments. The hindwing is thus well seen dorsally, much better than laterally. The 1st abdominal segment is narrower than those that follow, 0·7mm., compared with 1·4mm. or 1·5mm. of the 2nd to 7th abdominals; the width of the 5th, 6th, and 7th is doubtful, owing to breadth of incisions, the 8th is about 1mm., the 9th about 0·4mm., very narrow, and the pen of the cremaster with 10th segment, about 2·0mm., the 2nd to 8th (apart from free segments) have well-marked intersegmental subsegments, which are wrinkled and carry hairs like the rest of the segments. The wrinklings are in fine, transverse, anastomosing, waved lines. The hairs are numerous, 0·2mm. to 0·25mm. long, of a transparent, golden colour; to some extent in transverse rows, especially on posterior half of segment. On most of the segments are oval lenticles, apparently in position of i and ii; these are sometimes absent, and sometimes difficult to see, since they seem to be filled up level (normally when alive ?) by a yellow matter, which, in some, is *in sitû*, in others wanting, and in a few displaced more or less, and looks like (as magnified) an oval cake of beeswax. The site of iii is searched in vain, but in front, and below spiracle, is another lenticle, diameter

rather over half that of spiracle. The spiracles are paler than their surroundings, about 0·2mm. high, 0·1mm. broad, but with a raised and wrinkled area around, of twice or three times these dimensions. The rounded end of the 10th abdominal segment is about 1·0mm. in length, and rather broader at its base, if an end can be called rounded that gives off from its dorsal half the cremastral spine or pen, about 1mm. long, about 0·3mm. thick, and 0·9mm. wide at its base. Dorsally, it is not marked off from the rest of the segment, but seen laterally, it is a thin pen-like plate continuing the dorsal surface backwards, but with the ventra sweep of the dorsal surface. It terminates in a close-set bunch of hooks, closer set, perhaps, by being drawn together by the silk wound round them, which prevents much accuracy in describing them; they are brown, with ends closely curled round to about a complete circle; in length they may be 0·25mm., and in number 20 to 40. The ventral aspect of the abdomen presents similar arrangements of hairs and sculpturing. The scars of prolegs on the 4th, 5th and 6th abdominals are close-set groups of the structures we have called lenticles, 5 in number on the 4th, and 11 and 12 on the 5th and 6th, with, on one side of 6th, a very large one in front of, and outside, groups. The underside of cremastral spine is longitudinally fluted, in front of it is the anal scar, with similar flutings on each side. The 9th and 10th abdominal segments are well demarked dorsally, but the 9th slopes to nothing laterally, and ventrally no suture is visible; there are two round eminences in front of this area (the pupa is a male), and behind them a small smooth patch in front of the long anal incision. The hairs or bristles beneath the 10th segment are rather longer and stronger than the mass of dorsal hairs (about 0·27mm.). The lateral and ventral aspect have partly been dealt with in dealing with the abdominal segments, whilst the dehiscence has so disordered the head and thoracic aspect as to make any connected view of them erroneous. It remains, therefore, to deal with appendages individually as well as may be. First the prothoracic spiracle wants another word. It is covered by an oval lappet, as is common; this lappet is pale in colour and rough in surface; its appearance suggests that it is covered by an exudation, similar to that of *Hesperia malvae* pupa, but, in the case of *H. malvae*, it surrounds but does not affect the lappet; here it specially affects the lappet, and the area around appears to furnish none of it. The position of the labrum appears to be rather frontal than ventral, but the parts being loose this must be left doubtful. It is rather obscure and overlapped by two great flaps from either side, that are not merely marked off by sutures, but appear really to overlap. These are large (about 0·6mm. across), meet in the middle line, are wrinkled and somewhat paler on their margins, they are nearly circular, but that their base, a definite suture, runs across in nearly a straight line. A small diamond of labium is visible below them, these forming the front, the maxillæ the posterior, two of its four margins. The eye-piece (the glazed eye and the circle within) separate from the head and adhere loosely to the legs. The antennæ also separate from the head, and for about a third of their length; they terminate about three-fifths down the wing margins; the first leg is rather short of this, whilst the second goes half the rest of the way towards the end of the wing, lying against it beyond the antennæ. The second leg reaches up to the eyes, but by a margin only about one-third that of the first leg. The maxillæ, having the usual broad

base and just reaching out to the eyes, are long, and form the free maxilla-case already noted, which is received into a slight hollow in front of the 5th and 6th abdominal segments, and is supported by a pointed extension of the wing apices. All these appendages are transversely striated, but, for the most part, these striations are very smoothed down; the free portion of the maxilla is, however, quite rough with very fine circular ridges (like a rat-tail file). The wings are very smooth though really wrinkled like the other appendages, and the veins and Poulton's line (marginal vein) are very distinct as raised lines (Chapman).

Time of appearance.—The species is single-brooded, appearing on the wing in most seasons, continuously, for six to eight weeks, its earliest appearance depending largely on the season, and may be as early as May (April in 1893) and as late as July. May examples are usually rare, from mid-June to end of July is the usual period in Britain. Abroad, the time of appearance varies according to altitude and latitude—at Locarno in April and May; at Broussa it appears in May; from June to August, at 900m. elevation, in Roumania; from the end of May to mid-July in Anhalt (Gillmer); and mid-June to end of July (once on May 15th) in the Baltic Provinces (Nolcken); we usually find it worn in the Alps of France, Italy and Switzerland from 4000ft.-6000ft. at the end of July and early August. There may, in some seasons, be an occasional specimen of a second brood, but even this is very doubtful, and we suspect greatly all general records of double-broodedness, *e.g.*, at Salzburg, May 7th-June 23rd and July 25th-September 12th (Fritsch). The following dates will illustrate the variation according to season and place. Continental records: June 21st, 1871, very abundant in Jersey (Luff); June 24th-July 13th, 1883, at Carlsbad (Becher); June 14th-16th, and again July 19th-23rd, 1890, at Tancarville (Leech); May 22nd, 1891, in Corfu; June 4th, 1891, at Malamocco (de la Garde); abundant in the Vallon des Fleurs, Nice, July 1st, 1893 (Bromilow); July 28th-August 8th, 1894, at Courmayeur; July 25th-26th, 1896, at Grésy-sur-Aix; June 18th-26th, 1897, at Fontainebleau; July 28th-August 1st, 1897, at St. Michel de Maurienne; August 10th-19th, 1897, at Susa, scarce and apparently over (Tutt); June 20th-July 2nd, 1898, at Saeterstoen (Chapman); one specimen worn, early August, 1898, at Pré St. Didier (Tutt); June 21st to end of month, 1899, at Susa (Brown); July 1st-12th, 1899, at Fusio; July 22nd-31st, 1900, at Guarda (Chapman); June 26th-28th, 1900, at Berchtesgaden; June 29th-July 2nd, 1900, at Buda-Pesth (Lang); August 1st-3rd, 1900, at Larche; August 18th-24th, 1900, at Grésy-sur-Aix (Tutt); June 23rd-24th, 1901, at Mont Sény (*teste* Nicholl); June 26th-30th, 1901, distributed throughout the Forêt d'Arques and occurring abundantly (Moore); July 18th-20th, 1901, at Tragacete; July 28th, 1901, at Albarracin (Chapman); July 30th, etc., 1901, abundant but worn at Torre Pellice (Tutt); May 29th-July 4th, 1902, at Hyères (Powell); July 5th-30th, 1902, at Villars (Moss); July 12th, 1902, at Aigle (Sheldon); July 25th, 1902, at Grésy-sur-Aix; July 29th-31st, 1902, at Annecy (Tutt); June 26th-July 1st, 1902, at St. Georges (Wheeler); April 20th, 1903, a single newly-emerged specimen at Locarno (Tutt); July 2nd, 1903, at Entrevaux (Powell); July 26th, 1903, very large ♀s at Vésubie, with *T. acteon* (Rowland-Brown); July 27th, 1903, at Roche, near Aigle; July 28th and August

13th, 1903, at Useigne (Tutt); June 17th-July 3rd, 1903, at Macolin and in the Grindelwald (Lowe); May 30th-31st, 1903; May 31st, 1904, at Hyères (Powell); July 14th, 1904, at Mendel (Rowland-Brown); July 26th, 1904, on the Faucille; July 28th, 1904, on the Grand Salève; August 5th, 1904, between Stalden and Hüteck; July 28th-31st, 1905, at Grésy-sur-Aix; August 9th-13th, 1905, at Pré St. Didier; August 12th, 1905, in the Vel Véni (Tutt). BRITISH RECORDS: There appears to be a continual appearance of this insect from late May till the beginning of September in some years at Market Rasen (Court); common from May-August in the Chatham district; common end of June and early July in Tring dist. (Rothschild); at end of June round Carlisle (Day); June 30th and August 14th, 1856, at Hollingbury Combe (Image); June 22nd, 1860, at Mansfield (Brameld); May 19th, 1869, abundant at Cirencester (Harman); June 5th-26th, 1869, at Brockenhurst (Capper); imago emerged June 9th, 1871, from pupa obtained from larva found May 6th, 1871, in the Gloucester district (Watkins); June 6th, 1872, at Monk's Wood; June 13th, 1873, at Danbury (Raynor); July 24th and August 4th, 1873; July 5th, 1874; June 13th and August 15th, 1875, at Wimbledon; June 1st-8th, 1876, in Blean Woods; June 25th, 1876, at Darenth (Whittle); July 23rd-31st, 1882, in New Forest (Dobson); August 6th, 1882, at Marlow (A. H. Clarke); July 2nd-16th, 1883, in Abbott's Wood (Thornewill); July 13th, 1884, at Hailsham (Whittle); June 20th, 1885, at Abbott's Wood; July 18th-August 1st, 1885, in the New Forest enclosures (Hawes); imago reared from a larva found at Guildford, June 19th, 1886, (Grover); July 4th, 1886, at Reigate (Whittle); August 8th, 1886, at Brentwood (Burrows); July 17th, 1887, and July 1st, 1888, at Marlow (A. H. Clarke); June 16th-August 21st, 1888, at Downham Market (Smith); July 1st, 1888, at West Hamble (Whittle); August 12th, 1888, at Lyndhurst (Blaber); July 13th, 1888, at Chattenden; July 21st, 1888, at Cuxton; July 6th, 1889, at Kingsdown (Tutt); June 24th, 1888; July 16th, 1889, at Brentwood (Raynor); June 22nd-August 1st, 1889, at Downham Market (Smith); June 30th, 1889, at Shoeburyness (Whittle); July 21st, 1889, at Marlow (A. H. Clarke); July 31st-August 5th, 1889, at Lyndhurst (Hill); June 5th, 1890, at Lockerley (Burrows); June 12th, 1890, at Chattenden (Tutt); June 15th, 1890, at Benfleet; July 13th, 1890, at Gt. Wakering (Whittle); June 16th-July 24th, 1890, at Downham Market (Smith); June 24th, 1890, at Dursley (Griffiths); June 28th-July 17th, 1890, at Brockenhurst (Blagg); August 18th, 1890, at Marlow (A. H. Clarke); June 14th, 1890; June 28th, 1891, at Brentwood (Raynor); July 5th, 1891, at Shoeburyness (Whittle); August 1st, 1891, between Poultin and Cleorleys (Baxter); July 1st, 1891; June 11th-18th, 1892, at Chattenden (Tutt); June 15th, 1892, at Rainham (Burrows); June 2nd-9th, 1892, at Hailsham and Abbott's Wood (Tugwell); June 17th-July 13th, 1892 at Purbeck (Bankes); July 22nd, 1892, in the New Forest (Alderson); June 8th, 1892; May 25th, 1893, at Langworth (Raynor); April 17th, 1893, at Worcester Park (Kaye); April 29th, May 20th, June 3rd and 7th, 1893, in Chattenden and at Cuxton (Tutt); May 4th, 1893, in North Devon, an exceptionally early year (Hinchliff); May 11th, 1893, at Ventnor (Christy); May 21st, 1893, at Brockenhurst (Tremayne); June 24th-July 10th, 1893, at Morthoe (Sheldon); July 6th, 1893, at Monk's Wood (Blake); June

2nd-10th, 1893; July 14th, 1894, in Isle of Purbeck (Bankes); June 16th, 1894, at Chattenden (Tutt); June 17th, 1894, at Blandford (Bankes); June 8th-17th, 1894, at Brockenhurst (Wells); common in the New Forest in July, 1894 (Cox); July 8th, 1894, at Southend (Whittle); July 20th, 1894, at Darenth Wood (James); July 29th, 1894, at Haverthwaite (Arkle); June 22nd, 1894, at Legsby; May 27th, 1895, at Langworth (Raynor); June 16th, 1895, at Great Wakering, June 23rd, 1895, on the Leigh slopes (Whittle); June 18th, 1895, at Leigh (Burrows); June 23rd, 1895, at Boxhill (Nth. Lond. Nat. Soc.); July 7th, 1895, at Marlow (A. H. Clarke); June 13th, 1896, in good condition at Oxshott (Tremayne); June 28th, 1896, at Canvey (Whittle); July 3rd, 1896, at Canvey (Burrows); mid-July, 1896, in the New Forest (Bayne); June 21st, 1896, in Isle of Purbeck (Bankes); May 25th, 1896, at Langworth, June 11th, 1897, at Hazeleigh (Raynor); June 5th and 6th, 1897, at Benfleet (Whittle); June 5th, 1897, one at Cairn Ryan (Gordon); June 28th-July 3rd, 1897, at Balcombe (Image); July, 1897, at Carlisle (Day); fairly common, June 12th, 1897, at Harrow Weald (Rowland-Brown); June 26th, 1897, at Bentley (Burrows); July, 1897, at Alderbury Down (Barraud); fairly common in June, two specimens captured late in August, 1898, in the Penzance district (Daws); June 16th and 19th, 1898, at Hockley; July 30th, 1898, at Hadleigh (Whittle); June 28th, 1898, at Mucking (Burrows); June 21st-mid-July, 1898, at Hythe (Hill); July 1st, 1898, at Theydon Bois (Image); July 2nd, 1898, at Leicester (Dixon); July 2nd, 1898, at Stanmore Common (Barraud); ♂ taken near Ravens Hall, July 9th, 1898; July 12th, 1898, at Corsemalzie (Gordon); June 17th, 1898, June 24th, 1899, at Hazeleigh (Raynor); earliest appearance May 23rd, 1899, in the Gloucester district (Davis); June 10th-11th, 1899, at Shoreham; July 20th, 1899, at Oxshott; August 5th, 1899, at Hailsham (Carr); June 25th, 1899, at Prittlewell (Whittle); July 15th, 1899, at Monkswood (Rowland-Brown); May 1st-June 16th, 1900, in the Frensham district (Bingham-Newland); June 17th-18th, 1900, at Bexley; July 14th, 1900, at Esher (Carr); June 17th, 1900, at Eastwood; July 1st-8th, 1900, at Benfleet (Whittle); latest appearance, June 18th, 1900, in the Gloucester district (Davis); July 1st, 1900, at Reading (Butler); June 16th, 1900, July 7th, 1901, at Hazeleigh (Raynor); June 15th, 1901, between Port Carlisle and Carlisle (Nicholson); June 20th, 1901, at Prittlewell; July 6th, 1901, at Westcliff (Whittle); June 22nd, 1901, at Mickleham (Ashdown); July 14th, 1901, at Reading (Butler); July 17th, 1901, in West Sussex (Bird); August 5th-7th, 1901, at Burgess Hill (Dollman); June 13th, 1902, at Mucking (Burrows); June 25th, 1902, at Reading (Butler); July 2nd, 1901, at Epping (Image); July 5th, 1902, at Wisley (Lucas); July 10th, 1902, at Corsemalzie (Gordon); July, 13th, 1902, on Thundersley Common (Whittle); July 3rd and 17th, 1902, in West Sussex (Bird); July 18th, 1902, at Tilbury (Image); July 28th, 1902, at Sledmere (Tetley); August 5th, 1902, on Stanmore Common (Barraud); July 31st-August 25th, 1902, at Burgess Hill (Dollman); August 5th and 8th, 1902, 2 ♀s in Merioneth (Graves); June 21st, 1902, June 20th, 1903, at Hazeleigh (Raynor); June 1st and 5th, 1903, at Reading (Butler); June 3rd, 1903, at Newtown; July 4th, 1903, at Scarborough; July 18th, 1903, at Sledmere (Tetley); June 22nd, 1903, at Dorking

(Oldaker); June 27th, 1903, in West Sussex (Bird); June 11th-July 2nd, in Isle of Purbeck (Bankes); July 5th, 1903, at North Shoebury (Whittle); July 11th, 1903, at Wendover (Turner); July 25th, 1903, at Oxshott (Pickett); June 10th, 1904, at Reading (Butler); June, 1904, in the New Forest (Barraud); June 19th, 1904, at North Shoebury (Whittle); June 28th-July 10th, 1904, at Mucking (Burrows); end of June, 1904, near Kirkmaiden (Gordon); June 26th, 1904, June 8th, 1905, at Hazeleigh (Raynor); June 5th, 1905, common at Reading (Butler); June, 24th, 1905, at Sledmere (Tetley); June 24th, 1905, at Noak Hill; July 1st, 1905, at Oxted (Harrison); June 25th-26th, 1905, at Sunny Braes (Gordon).

Habits.—The short, rapid flights of this species, and its strange habit of moving round and round on a leaf were noticed in 1778 by Harris, who says that "whenever they settle, which is very frequent, as they are never long on the wing, they are sure to turn halfway round, and sometimes quite round; when on the wing they have a skipping motion, which is effected by reason of their closing their wings so often in their passage; whenever they settle they also close their wings." Lewin also notes that "its flight is very short, but when on a bush or shrub it is almost constantly in motion, skipping or leaping from leaf to leaf." We have ourselves noticed its apparent preference for bramble and hazel on which to rest if in its locality. Raynor says that it has also a habit of flying rapidly up and down the sheltered side of a sunny hedge. The upright position of the forewings and horizontal position of the hindwings, as the insect sidles round, must have been noted by everybody. The butterfly sits with its wings right up over its back when sucking honey from a flower, also when quite at rest or when asleep, but when sunning allows its forewings to drop considerably until they make an angle of perhaps 30° from the horizontal, the hindwings being allowed to drop still lower. When it first settles, it holds both wings together up vertically over its back, then lets fore- and hindwings down together for about 30°, when the lower ones are still further depressed as noted above. The hindwings are, however, never depressed horizontally to anything like the amount noticeable in *Adopaea lineola* or *A. flava*. When disturbed the hindwings are quickly drawn up to the inclination of the forewings and the insect starts suddenly and rapidly off. It chooses generally a leaf on which to sun, but also very frequently a flower, and it abounds in various places—by the sides of hedges, in woodridings and clearings in woods (loving particularly sunny corners), downs where shrubby herbage and bushes occur, and we have seen it abundant in lucerne fields, in a clover field above Grésy-sur-Aix, flowery mountain slopes (between Bourg St. Maurice and Bonneval-Bains, and Pré St. Didier and Courmayeur), occasionally drinking at the roadside runnels on the rocky mountain paths, although less usually so than any of its near relations. It was particularly abundant in 1905 at Grésy-sur-Aix, at the end of July at Bourg St. Maurice, and at Pré St. Didier in early August. We found worn specimens on the flat in the Val Véni, nearly up to the foot of the Glacier de Miage on August 12th, at an elevation of some 5000 ft. Dupont notes that at Pont de l'Arche the species rests habitually on the leaves of the bushes in the forest, and Schütze that in Upper Lusatia it prefers the fronds of *Pteris aquilina* on which to rest.

Habitat.—In Britain, the ridings and open places in woods, bushy

places on the outskirts of woods, lanes in wooded districts, rough bushy places on open downs, undercliffs on the coast, and flowery meadows near lanes, are among the most favoured haunts of this species. Harris, in 1778, noticed that it loved the neighbourhood of woods, and Lewin added downs to its haunts. Grassy places in woods, old pastures, the edges of downs in Bucks., etc. (Rothschild), near woods and settling preferably on bramble and bracken at Cranbrook (Marshall), by dusty roadsides and in swampy land near Penzance (Daws), on the saltmarshes at Cliffe (Bower), in a chalkpit at Boxhill (Prout), common in woods and lanes in Chatham district (Walker), in woods and on bushy hillsides at Hereford (Bowell), on grassy slopes near the sea in Wigtownshire (Gordon), the coast sandhills at Llandudno (Harding), in meadows and woods near Carlisle (Day), but common on Skiddaw and other mountains among bracken (Beadle), etc. In lowland districts abroad its localities are similar, open spaces in woods at Wiesbaden, pastures and glades in Roumania, in the park-like King's gardens in Corfu, and the sandbanks of Malamocco at the mouth of the Venice lagoon (de la Garde), etc., but among the mountains of the central Alps it is to be found in all sorts of situations—of which the lucerne fields at Susa, Grésy-sur-Aix and Chavoire, the wild flower wilderness at the foot of the Grande Gorge, past Veyrier, the thistle-thickets at Pré St. Didier, the flowery upland pastures of Larche, the Val Véni, and the summit of the Faucille, the mountain pathsides from Evolène to Useigne, from Stalden to Saas-Grund, from Courmayeur to the foot of the Brenva Glacier, and the zigzags below Crissolo occur to us.

British localities.—Bedford: Bedford (Court). Berks: Reading (Butler), Purley (Buckstone), Bagley Wood, Boars Hill, Tubney, Streatley (Geldart). Bucks: very common between Princes Risborough and Wendover (Rowland-Brown), Halton, Wavendon near Newport Pagnel (*teste* Stainton), Drayton Beauchamp (Rothschild), Stony Stratford (Foddy), Marlow (Clarke). Carnarvon: common near sea (Arkle), Conway Valley (Bland), Abersoch (Day), mouth of the Conway (Gardner), Llandudno sandhills (Harding). Cambridge: Wicken, common (Carr), Cambridge district (Waters). Cheshire: local and rare (Day), north Cheshire (Greening), between Raby and Bromborough (Walker), Knutsford (Chappell), throughout, Wirral (Brockholes), Goostrey, common (Thorpe), Ince Marshes, sparingly (Newstead), Whixall Moss near Fenn's Bank Station (Thornewill). Cornwall: Penzance district (Daws), near Bude (Rothschild), Truro (Rollason), Trelawewry, abundant (Perry-Coste), Polzeath near Padstow (Gibb). Cumberland: common on Skiddaw, near Keswick (Beadle), Carlisle (F. H. Day), between Port Carlisle and Carlisle (Nicholson), Thurstonfield, Orton, Newby Cross (Dawson). Denbigh: Colwyn Bay (Newstead), Cefn Caves (Gardner), Ruthin (Butler). Derby: district south of Trent, not uncommon (Brown), Melbourne district, rare (Crewe), Burton-on-Trent dist. (*teste* Stainton), Bagot's Park (Thornewill), Chartley dist. (Harris). Devon: common throughout (Mathew), Sidmouth (Majendie), North Devon (Hinchliff), Morthoe, near Ilfracombe (Sheldon), Exeter, Plymouth, Teignmouth (*teste* Stainton), Dartmoor (Gummer), Torquay (Crocker), Honiton, abundant (Riding), Paignton (Goodale), Buckfastleigh (de la Garde). Dorset: Portland, uncommon (Richardson), Lulworth (Dale), Dorchester (*teste* Stainton), Blandford, Purbeck (Bankes), Hambledon Hill, Wimborne (Fowler), Sherborne (Douglas), Silverton (Ward), South Dorset abundant (Bogue). Durham: local, Durham district (Harrison), very rare, Darlington (Sang), Castle Eden Dene (Wailes), Hesleden Dene (Leeming). Edinburgh: Edinburgh (*teste* Stainton). Essex: Southend, Shoeburyness, Leigh, Benfleet, Great Wakering, Canvey, Hockley, Hadleigh, Eastwood, Prittlewell, Westcliff, Thundersley (Whittle), Epping Forest (Garland), Theydon Bois, Tilbury (Image), Noak Hill (Harrison), Forest Gate (Mera), Brentwood, Danbury, Hazeleigh (Raynor), Mucking, Rainham (Burrows), Harwich district (Mathew). Flint: coast districts (Gardner), Bagillt (Walker), Overton (Perkins). Glamorgan: Swansea, common (Robinson), Cwityralla (Shelley). Gloucester: Bristol district, generally distributed

and common (Hudd), Dursley (Griffiths), Cheltenham (Robertson), Lower Guiting (*teste* Stainton), Cranham (Rothschild), Cirencester (Harman). HANTS: common everywhere throughout the county—Bournemouth, New Forest (Sequeira), common, Winchester (Hewett), Isle of Wight—Bembridge (Stainton), Ventnor (Christy), Freshwater (Rothschild), Lyndhurst (*teste* Stainton), Brockenhurst (Hodson), Bank near Brockenhurst (Carr), Portsmouth (Pearce), Ringwood (Fowler), near Silchester (Rothschild), Lockerley (Burrows). HEREFORD: Hereford (Bowell), Tarrington (Wood), Leominster (Hutchinson). HERTS: Oxhey (Rowland-Brown), Norton Green Woods (Matthews), Hertford (Stephens), Hitchin, Sandridge (Griffith), Tring district, Aldbury (Cottam), Harpenden, Shenley, Bricket Wood (Gibb), Haileybury (Bowyer), East Barnet (Gillum), Watford (Spencer). HUNTS: abundant—St. Ives, etc. (Norris), Monks Wood (Raynor). ISLE OF MAN: (Owen) ? [(Clarke)]. KENT: common throughout—Rochester, Strood, Cuxton, Chattenden, Higham, Cliffe, Sandwich, Deal, St. Margaret's Bay, Dover, Folkestone, Kingsdown, etc. (Tutt), Chatham (de la Garde), Ashford common (Wood), Bexley (Fenn), Chatham district (Walker), Hythe (Hill), Pembury (Weir), Ramsgate, Tenterden (*teste* Stainton), Maidstone district (Golding), Shoreham (Carr), Sevenoaks (Holmes), Sheerness (Fletcher), Cranbrook (Marshall), Darenth Wood (James), Blean Woods near Herne (Whittle), Herne Bay (Battley), Brockley (Turner). KILDARE (Birchall). KERRY: Killarney—on Lord Kenmare's demesne (Watts). KIRKCUDBRIGHT: near Ravens Hall (Gordon). LANCASHIRE: between Poultin and Cleorleys (Baxter), Grange (Hodgkinson), Silverdale (Melvill), Simonswood Moss, Crosby sandhills (Gregson), Manchester, Preston (*teste* Stainton), Methop (Forsythe), Haverthwaite (Arkle), Carnforth (Murray). LEICESTER: Leicester (Dixon), Sixhills, Ratcliffe, Ashby Flamville, Barkby (Rowley), Gumley (Matthews), Loughborough (Wieldt). LINCOLN: Ashby near Brigg (Cassal), Newball, Skellingthorpe (Carr), Market Rasen (Court), Langworth, Legsby (Raynor). MERIONETH: Tan-y-Bwlch to Harlech, Barmouth district—Artro Valley (Arkle), Merioneth (Graves). MIDDLESEX: East Acton (Ince), Stanmore (Bond), Harrow district (Melvill), Kingsbury (Godwin), Enfield (Sykes), Pinner, Harrow Weald, Oxhey Lane (Rowland-Brown), Old Oak Common (Godwin), Mill Hill (South), Ruislip Common (Woodbridge), Hampstead (Sharp). MONMOUTH: Monmouth (Palmer), Llandogo, rather scarce, Dingestow (Bird), Abertillery, common (Smith). MONTGOMERY: common—Newtown, etc. (Tetley). NORFOLK: Downham Market (Smith). NORTHAMPTON: Peterborough, common (Morley), Ashton Wold, Oundle (Rothschild), Northampton (Hensman). NOTTS: Nottingham district (Leivers), West Bridgford (Simmons), Newstead Park, near Mansfield (Wright), Mansfield (Brameld). OXFORD: Shotover, Cowley, Nettlebed (Geldart). RADNOR: Llandrindod Wells (Denson). ROXBURGH: Hawick (Renton), Roxburgh (Douglas). SHROPSHIRE: Shrewsbury (*teste* Stainton), Hopton Wafers (Boxer). SOMERSET: Castle Cary (Macmillan), Taunton (Doidge). STAFFORD: Burnt Woods, scarce (Daltry), Maer (Blagg). SUFFOLK: common (Bloomfield), Stowmarket (*teste* Stainton), Depden near Bury St. Edmunds, very common (Rowland-Brown), Needham Market (Raynor), Bentley (Burrows). SURREY: Boxhill (N. L. Nat. Soc.), Dulwich (Helps), Oxshott (Tremayne), Guildford (Grover), Esher, Horsley (Carr), Ranmore, Polenden, Dorking (Oldaker), Worcester Park (Kaye), Wimbledon, Reigate (Whittle), Dorman's Park (Burr), Frensham (Bingham-Newland), Oxted (Harrison). SUSSEX: West Sussex, common (Fletcher), East Sussex, generally common (Jenner), Pagham (Lloyd), Hastings district, common (Bloomfield), Eastbourne (Sotheby), Birling Gap (Adkin), Brighton, Lewes, Worthing (*teste* Stainton), Hailsham (Carr), Abbott's Wood (Tugwell), Balcombe, Hollingbury Combe (Image), Burgess Hill (Dollman). WARWICK: common, Marston Green (Wynn), Knowle (Ellis), Warwick, Oakley Wood (Baly), Rugby, Brandon Woods, Princethorpe (Rugby lists), Atherstone (Baker), Wolford Woods (Austen), Ettington (Keighley-Peach), Coombe Woods (Longstaff). WESTMORLAND: Kendal district (Moss), Lake district (*teste* Stainton), Witherslack (Forsyth), Brigsten (West), Arnside (Forsythe). WICKLOW: The Morrough of Wicklow (Birchall). WIGTOWNSHIRE: Corsemalzie, Cairn Ryan, one, Kirkmaiden, Monreilt, Sunny Braes (Gordon). WILTS: Calne (Eddrup), Salisbury (Carr), Savernake Forest (Kimber). WORCESTER: common (Fletcher), Worcester (*teste* Stainton). YORKS: Sheffield (Hall), Sutton (Russell), Hull (Boult), Askham Bog (Prest), Bishop's Wood (Grassham), Bramham (Smith), Edlington Wood, Thornwaste (Harrison), Ledstone (Smethurst), Pontefract (Hartley), Richmond (Sang), Scarborough (Rowntree), Sheffield (Doncaster), Wakefield (Talbot), York (*teste* Stainton), Thorne Woods, Wadworth Wood near Doncaster (Brooks), Sledmere (Tetley).

DISTRIBUTION.—The whole Palæarctic area (except Polar region, Canaries, Madeira, North Africa), Corea, China, Japan, Amdo district (Staudinger). ASIA: Amurland, Nicolaiesk, North and Central China (Elwes), Corea, Japan (Leech), Yokohama, Isle of Askold (Oberthür), Thian Shan to 6000ft. (Rühl), Asia Minor—Broussa, not common (Fountaine), Valley of the Khingoob (Romanoff), Syria—Akbès (Merkl), Amasia, Taurus, Persia—Lenkoran, Astrahabad, Pamirs (Rühl), Irak district (Young). AUSTRO-HUNGARY: common throughout (Höfner), Buda-Pest district (Nicholson), Katschau, Rosenau (Fritsch), Carinthia—Wolfsberg district (Lemann), Preth (Zeller), Friesach (Rühl), Tyrol district up to 6000ft.—the Schlückenalpe (Freyer), Gross Glockner, Trient, Val Popena, Cortina (Mann); Innsbruck, Taufers (Weiler), Solsteinkette, Kühtai, Patscherkofel, Glockner district, Seiser Alpe, Stilfser-Joch (Heller), Mendel district (Tutt), Botzen (Lowe), Austrian Alps—Gastein, the Bucovina (Hormuzaki), Bechtesgaden (Lang), Moravia, near Neutitschein (Fritsch), Brünn (Schneider), Bohemia— Carlsbad (Becher), Seftenburg (Fritsch), Salzburg, Upper Austria—near Linz (Fritsch), Enns district (Brittinger), Lower Austria—Vienna district, Hernstein district up to 1000m. (Rogenhöfer), Galicia (Garbowski), Funfkirchen, Hungary—Raab, Transsylvania, Jungerwald (Rühl), Croatia—Josefsthal, Slavonia—Zara (Mann). BELGIUM: common throughout (Lambillion), Ortho (Slégers). BOSNIA AND HERCEGOVINA: Jaice—Banjaluka (Rebel), Dervent (Hilf), Fojnica (Simonys), Bosnatal (Hilf), Trebevic, Sarajevo (Rebel), Prozor, Maklenpass (Hilf), Kalinovik (Schreitter), Jablanica (Apfelbeck), Prenj—Idbartal (Rebel), Risovac, 1000m. (Penther), Nevesinje (Uhl), Lakat (Apfelbeck), Vucija Bara (Hilf), Stolac (Winneguth). BULGARIA AND EAST ROUMELIA: common, Sophia, Rilo, Rustschuk, Varna, Slivno (Rebel). CHANNEL ISLANDS: Guernsey, Jersey, abundant (Luff). DENMARK (Bang-Haas). CORSICA: Monte Pozzo di Borgo (Kollmorgen). FINLAND: south and southeast (Lampa). FRANCE: throughout (Tutt)—dept. Nord (Paux), Brittany (Griffith), Pont de l'Arche (Dupont), Rennes—Forêt de Paimpont, coast from Cancale to St. Malo (Oberthür), Dieppe—Forêt d'Arques (Moore), Normandy—Tancarville (Leech), near Cherbourg (Nichollet), Sâone-et-Loire (Constant), Paris district—Fontainebleau (Tutt), Seine-et-Marne—Forêt d'Ozouer-la-Ferriére, Eure—Elbeuf (Coulon), Evreux, Aube (Jourdheuille), Auvergne district—Nohant, Sologne, St. Florent, Gueret, Auvergne, Le Livron (Sand), Allier—Moulins (Peyerimhoff), Aude (Mabille), Isère—Grenoble (Harrison), Uriage, Orne—Bagnoles (Oberthür), Indre — Brenne (Martin), Savoy Alps — Grésy-sur-Aix, Annecy, Chavoire, Dauphiny Alps—St. Michel-de-Maurienne, etc. (Tutt), Basses-Alpes—Digne (Oberthür), Entrevaux (Powell), Hautes Alpes—Barcelonette, Larche (Tutt), Alpes-Maritimes—Vallon des Fleurs, abundant (Bromilow), Nice to La Turbie (Oberthür), Hyères (Powell), Pyrenees—East and Central to 5000ft. (Elwes), Vernet-les-Bains, Cauterets (Oberthür), Pierrefitte, St. Sauveur (Bath), Guéthary, St. Jean-de-Luz (Chapman), Haute-Garonne (Caradja), Doubs (Bruand). GERMANY: Prussia—Dantzig, Königsberg (von Siebold), Rastenburg, Insterburg, Willenberg (Schmidt), Tilsit, Cranz, Rauschen, Warnicken, Caporns' Haide, Wargen, Dammhof, Gross-Raum, Pillkallen, Friedland, Mohrungen, Osterode, Allenstein, etc. (Speiser), Mecklenburg—Neustrelitz, Rülow, Sülze, Wismar (Boll), Lübeck (Tessmann), Schwerin, Waren, Parchim (Gillmer), Pomerania—Grubenhagen, Kieshof, Negast (Paul and Plötz), Schleswig-Holstein, etc.—Eutin (Dahl), Hamburg (Heske), Altona (Tessien), Lauenburg (Boie), Heligoland (Dalla Torre), Hanover, etc.—Bremen (Rehberg), Lüneburg (Machleidt), Hanover (Glitz), Osnabrück, Hameln, Göttingen (Jordan), Brunswick — Wolfenbüttel (Heinemann), Helmstedt, Quedlinburg (Jordan), Hartz, everywhere common (Speyer), Westphalia—Münster (Speyer), Höster (Jordan), Rhine Provinces—St. Goarshausen (Baker), Crefeld, Uerdingen, Aix, Cologne, Elberfeld, Bonn, Boppard, Bingen (Stollwerck), Barmen (Weymer), Neuenahr (Maassen), Hesse-Nassau, etc.—Nassau, Wiesbaden (Rössler), Oberhessen, Oberursel, Hanau (Limpert), Gressen, on the Vogelsberg (Glaser), Frankfurt-an-Main (Koch), Cassel (Borgmann), Waldeck (Speyer), Rollenburg (Jordan), Thuringia—throughout (Knapp), Erfurt, etc. (Keferstein), Rudolstadt (Jordan), Saxony—Zeitz-an-Elster (Wilde), Halle (Stange), Dessau (Richter), Klein-Zerbster, etc. (Gillmer), Mühlhausen, Naumburg, Nordhausen, the Kyffhauser (Jordan), Chemnitz (Pabst), Dresden (Steinert), Fresborg (Fritsche), Brandenburg, common throughout—Berlin district (Bartel), Frankfort-an-Oder, etc. (Kretschmer), Posen—Eichwald, Kobylepoli (Schultz), Silesia—Brieg (Döring), Oberlausitz (Möschler), Sprottau district, Kortnitz, Hochwald, Altkirch (Pfitzner), Bavaria—Regensburg (Hoffmann), Munich (Kranz), Augsburg (Freyer), Kempten (von Kolb), Württemberg—throughout (Seyffler), Baden—Constance, Triberg, Dinglingen, Carlsruhe,

Heidelberg (Reutti), Alsace—throughout (Spuler), the Palatinate (Bertram). Greece: Mesolonghi (Fountaine), Corfu (de la Garde), Parnassus, Acarnania, Negropont (Rühl). Italy: Piedmontese Valleys—Pré St. Didier, Courmayeur, Val Véni, Susa, Bobbie, Torre Pellice, Crissolo (Tutt), Certosa di Pesio (Norris), throughout Tuscany (Stefanelli), Appenines—near Boscolungo (Norris), Lake Como (Fountaine), Lombardy (Turati), Roman Campagna (Caradja), Messina (Rühl), Sicily—Etna to 1400m., Madonie, S. Martino, Ficuzza (Struve), Messina, Calabria (*Isis*, 1847), Malamocco (de la Garde). Netherlands: rather rare—South Holland (Snellen), Brabant, Flanders (Rühl). Roumania: throughout, near Comanesti, Tulcea, Slanic at 900m. (Caradja). Russia: Caucasus (Bramson), Baltic Provinces—throughout (Nolcken), Kasan, Ural dist.—Busuluk, Sergievsk (Eversmann), Gorki, Black Sea district—Novorosiisk (Rühl). Scandinavia: Sweden south, Helsingland (Lampa), Norway south and centre—Sireosen, Haegstöil, Ose (Strand), Saeterstoen, Disenaen, etc. (Standen), northeast Scania (Wallengren), Lapland, very rare (Zetterstedt), Odalen, near Skien, Naes Vaerk, Bergedal, Tyldal, near Christiania (Siebke), Stryn (Pettersen). Servia: Nisch (Hilf). Spain: Albarracin, Tragacete (Chapman), Mont Sény (Nicholl), Andalusia—Sierra Prieta (Rambur), Sierra Nevada, Bilbao (Rühl), Punto de Pajares (Chapman). Switzerland: widely distributed—going high into the mountains up to 6000ft. on the Stelvio (Frey), Rhone Valley—Aigle (Sheldon), Sépey (Wheeler), La Roche (Tutt), Villars, Gryon (Moss), Juras—St. Georges (Wheeler), the Faucille (Tutt), Bernese Oberland—Grindelwald, Macolin (Lowe), Visp-Thal—Stalden to Zermatt, Saas-Thal—Stalden to Saas-Grund, Val d'Hérens—Useigne to Evolène, etc., Grand-Saléve near Geneva, Locarno (Tutt), Fusio, Guarda (Chapman), Zürich, Bergün (Rühl), Lausanne (Fountaine). Turkey: Port Baklar (Walker).

## Genus: Urbicola [Linné], Barbut.

Synonymy.—Genus: **Urbicola,** Barbut, "Gen. Ins. Linn.," p. 173 (*pars* ref. to Linné, no. 162 (1781). [**Papilio- Plebeius-**] **Urbicola,** Linné, "Syst. Nat.," 10th ed., p. 484 (1758); 12th ed., p. 793 (1767); Fab., "Sys. Ent.," p. 531 (1775); Esp., "Schmett. Eur.," i., pl. xxiii., figs. 1*a*-*b* (1777); p. 300 (1779); Goeze, "Ent. Beit.," ii., pt. 3, p. 101 (1780); Fab., "Spec. Ins.," ii., p. 131 (1781); "Mant.," ii., p. 84 (1787); Bork., "Sys. Besch.," i., pp. 179, 284 (1788); Schwarz, "Neu. Raupenkal.," p. 180 (1791); Haw., "Lep. Brit.," p. 50 (1803). **Papilio,** Linn., "Faun. Suec.," 2nd ed., p. 285 (1761); Hüfn., "Berl. Mag.," ii., pp. 74, 89 (1766); Fuess., "Verz.," p. 32 (1775); Schiff., "Schmett. Wien.," 1st ed., p. 160 (1775); Rott., "Naturf.," vi., p. 8 (1775); Harris, "Eng. Lep.," p. 6 (1775); Müller, "Zool. Dan. Prod.," p. 115 (1776); Retz., "Gen. et Spec.," p. 31 (1783); Schneider, "Sys. Besch. Eur. Schmett.," p. 272 (1785); Lewin, "Ins.," etc., p. 94; pl. xlv., figs. 1-2 (1775); Hb., "Eur. Schmett.," pl. xcv., figs. 479, 480, 481 (1802); p. 72 (*circ.* 1805); Ill., "Schmett. Wien.," 2nd ed., p. 146 (1801); Ochs., "Die Schmett.," i., pt. 2, p. 224 (1808); Godt., "Hist. Nat.," i., p. 237, pl. xii. tert., fig. 4 (1821); Freyer, "Neu. Beit.," vii., p. 79, pl. 646, figs. 1*a*-*d* (1858). [**Papilio-**] **Plebeius,** Müll., "Faun. Frid.," p. 37 (1764). [**Hesperia-**] **Urbicola,** Fab., "Ent. Syst.," iii., pt. 1, p. 325 (1793). **Erynnis,** Schrank, "Faun. Boica," ii., pt. 1, p. 159 (1801); Watson, "Proc. Zool. Soc. Lond.," p. 99 (1893)*; Kirby, "Handbook," etc., iii., p. 24 (1897); Grote, "Proc. Sth. Lond. Ent. Soc.," p. 59 (1897). **Hesperia,** Latr., "Hist. Nat.," xiv., p. 124 (1805); "Gen. Crust.," iv., p. 356 (1809); "Consid. Gen.," p. 208 (1810); Leach, "Edin. Encycl.," ix., p. 130 (1815); Ochs., "Die Schmett.," iv., p. 34 (1816); Dalm., "Vet. Ak. Handl.," xxxvii., p. 201 (1816); Latr., "Enc. Méth.," p. 169 (1819); Sam., "Ent. Comp.," p. 242 (1819); Bdv., "Eur. Lep. Ind. Meth.," p. 27 (1829); Meig., "Eur. Schmett.," p. 66 (1830); Treits., "Die Schmett.," x., p. 248 (1834); Bdv., "Ind. Meth.," p. 35 (1840); Zett., "Ins. Lap.," p. 915 (1840); Dup., "Cat. Meth.," p. 35 (1840); Evers., "Faun. Volg.-Ural.," p. 87 (1844); H.-Sch., "Sys. Bearb.," p. 159 (1846); Dup., "Icon. Chen.," p. 213 (1849); Led., "Verh. zool.-bot. Gesell.," ii., p. 26 (1852); Speyer, "Geog. Verb.," p. 286 (1858); Hein., "Schmett. Deutsch.," p. 117 (1859); Wallgrn., "Skand. Dagf.," p. 260 (1853); Newm., "Brit. Butts.," p. 172 (1870); Snell., "De Vlind.," p. 85 (1867); Nolck., "Lep. Fn. Estl.," p. 84 (1868); Staud., "Cat.," 2nd ed., p. 35 (1871); Mill., "Cat. Lep. Alp.-Mar.," p. 116 (1872); Curò, "Bull. Soc. Ent. Ital.," p. 216 (1874); Frey, "Lep. Schweiz," p. 55 (1880); Lang, "Butts. Eur.," p. 353,

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* By a stupid blunder this reference is erroneously accredited as a synonym of *Augiades* (*anteà*, p. 132), it should of course be deleted there.

pl. lxxxii., fig. 2 (1884); Kane, "Eur. Butts.," p. 147 (1885); Auriv., "Nord. Fjär.," p. 39, pl. vii., fig. 12 (1889); Dale, "Brit. Butts.," p. 211 (1890); Barr., "Lep. Brit. Isl.," i., p. 294, pl. xxxix., figs. 2-2*d* (1893). **Pamphila,** Fab., "Ill. Mag.," p. 287 (1807); Oken, "Lehrb. Zool.," p. 759 (1815); Stephs., "Ill. Brit. Ent.," p. 102 (1828); "Ins. Cat.," p. 28 (1829); Wood, "Ind. Ent.," p. 10, fig. 81 (1839); Westd., "Gen. Syn.," p. 88 (1840); Humph. and Westd., "Brit. Butts.," p. 128, pl. xli., figs. 1-4 (1841); Dbldy., "Syn. List," p. 2 (1850); Westd. and Hew., "Gen. Diurn. Lep.," p. 522 (1852); Sta., "Man.," i., p. 69 (1857); Kirby, "Eur. Butts.," p. 123 (1862); Butl., "Cat. Diurn. Lep.," p. 277 (1869); Kirby, "Syn. Cat.," p. 824 (1871); "Eur. Butts.," p. 65 (1882); Buckler, "Larvæ," etc., i., pp. 142, 198 (1886); Rühl, "Gross-Schmett.," p. 646 (1895); Meyr., "Handbk.," p. 359 (1895); Tutt, "Brit. Butts.," p. 128 (1896). **Augiades,** Hb., "Verz.," p. 112 (1816); Stephs., "Illus.," iv., p. 405 (1834); "List," 1st ed., p. 23 (1850); 2nd ed., p. 21 (1856); Staud., "Cat.," 3rd ed., p. 92 (1901); Lambn., "Pap. Belg.," p. 275 (1902). **Heteropterus,** Ramb., "Faun. And.," p. 307 (1839); "Cat. Lep. And.," p. 88 (1858).

The *Urbicolae* was Linné's group name for the "skippers," and *Urbicola* was first used in a generic sense by Barbut, in 1781, when he cited *comma*, L., as the type (*anteà*, p. 130). The genus is described, under the name of *Erynnis*, by Watson (*Proc. Zool. Soc. Lond.*, 1893, p. 99), with *comma* as the type, as follows:

Antennæ short, less than half the length of the costa; club short, robust, terminal crook exceedingly minute. Palpi with the second joint densely scaled, third joint minute, suberect, bluntly conical. Neuration as in *Hylephila*,* except that vein 2 of the forewings is much nearer to the base of the wing in the ♂, and vein 7 of the hindwing is slightly nearer the base of the wing in both sexes. The stigma of the forewing is very similar to that of *Hylephila*,† except that it entirely fills the angle at the bifurcation of vein 2, while in *Hylephila* the discal stigma crosses the interspace beyond the origin of vein 2—*comma*, Linn., *colorado*, Sc., *manitoba*, Sc., *metea*, Sc., *florinda*, Butl.

## Urbicola comma, Linné.

Synonymy.—Species: **Comma,** Linn., "Syst. Nat.," 10th ed., p. 484, no. 162 (1758); 12th ed., p. 793, no. 256 (1767); "Faun. Suec.," p. 285, no. 1080 (1761); Müll., "Faun. Frid.," p. 37 (1764); Hufn., "Berl. Mag.," ii., pp. 74, 89 (1766); Fab., "Sys. Ent.," p. 531 (1775), etc. [N.B.—All references mentioned under the generic synonymy (*suprà*) are referable to *comma*.]

Original description.—*P. P.* alis integerrimis divaricatis fulvis; punctis albis lineolaque nigra. *Fn. Suec.*, 793. Merian, *Eur.*, 15, t. 48. Habitat in Europa (Linné, *Sys. Nat.*, 10th ed., p. 484). [*Papilio comma* alis integerrimis divaricatis fulvis: punctis albis, lineaque nigra. Papilio alis erectis ovatis integerrimis testaceo-griseis, tesserulis albis linea nigra sub superioribus. Habitat in Pratis. Descr. — Alæ primores concolores, flavæ, apice fuscescentes maculis pallidis: litura nigra linearis margine nuda subargentea in medio paginæ superioris. Secundariæ supra flavæ, pallidius maculatæ margine fuscescentes. Subtus griseæ maculis albidis, quadratis (*Faun. Suec.*, 2nd ed., p. 285).

Imago.—29mm.-40mm. Ground colour of all the wings bright fulvous, with broad dark marginal band to fore- and hindwings; an

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* Cell less than two-thirds the length of the costa; vein 5 from close to bottom of cell; vein 3 very close to end of cell; vein 2 considerably nearer to base of wing than to end of cell; in the ♀ this vein is slightly more remote from base of wing. Hindwing with vein 7 well before end of cell, almost equidistant from 6 and 8; discocellulars faint; vein 5 not traceable; veins 2, 3 and 4 all close together, 3 about twice as far from 2 as from 4 (Watson, *Proc. Zool. Soc. Lond.*, 1893, p. 101).

† ♂ with a linear discal stigma on forewing, extending from origin of vein 3 as far as vein 1, and edged exteriorly with an outwardly diffused streak of raised scales (Watson, *Proc. Zool. Soc. Lond.*, 1893, p. 101). The type of *Hylephila* is *phylaeus*.

angulated row of paler spots beyond the middle of the forewings, and a corresponding transverse row across hindwings; a pale discal spot on fore- and hindwings. [These spots almost identical in size, position and arrangement with those of *Augiades sylvanus*.] Underside greyish-fulvous or yellowish; the hindwings and apex of forewings spotted, the former with a conspicuous band of somewhat squarish white spots.

Sexual dimorphism.—The sexual variation is very distinct in this species. The ♀s (a large number being compared) average from 5mm.-7mm. larger than the ♂s, and are distinctly heavier in build. The ♂ has a deep velvety-black discal streak, placed obliquely across the centre of the wing, below the median nervure. It hugs the latter, however, towards the base, more closely than in *A. sylvanus*, and the androconial scales show as a silvery line therein. This is almost all that one notices with the naked eye, but "if one examines the patch with a magnifying power of 30 (fig. 21), one finds that it consists of three different parts: (1) A smaller part which lies in cell 1*b* and is separated by the second vein from (2) a larger part which lies in the cell close to the hinder median vein, and (3) a long, narrow part, somewhat broader outwards, which stands on the hind median vein and also a little into the cell, and suddenly stops at the point of origin of veins 3 and 4. The first two divisions are pretty similar to one another in formation. They consist, namely, of very closely appressed, highly characteristic androconia, which are placed in a hollow or depression corresponding with the size and form of the surface. The margins of this depression are clothed with large, silvery-grey "covering-scales," whose tips converge so that they completely cover the surface formed by the tips of the androconia, or leave open between them only a narrow slit through which one can see the tips (compare fig. 21) of the coal-black androconia. As the covering scales are, in different specimens, sometimes quite closed, sometimes pretty well separated from one another, it is probable that the insect can separate them or lay them one over the other as it likes, in order to expose or to cover the delicate androconia. It is just these covering-scales that produce the silvery stripe of the black "comma" which characterises this species. The third part of the ♂ patch is of a velvety-black colour distinctly inclining towards brown, and consists of vertically-placed scales which are of a beautiful wedge-shape with 2-3 toothed points, and, below, run uninterruptedly into the stalk. In their structure, they appear to resemble the ordinary scales, but their strong pigmentation, vertical position, and different arrangement, almost seem to me to indicate a special purpose, more or less analogous with that of the rest of the androconia. In the form of their base they also differ from the known type of normal scales in the Rhopalocera. Their length is 0·22mm.-0·36mm., and their breadth 0·027mm.-0·031mm. In cells 1*b* and 2, just outside the ♂ patch, the yellow wing-scales are larger, somewhat more erect, with tips bent down, so that in certain lights they give this part of the wing a distinct gloss. The peculiar androconia already mentioned (fig. 19) show a very surprising formation. They are cylindrical, hair-like, composed of a great number of members (or segments), which fall apart at the least touch. Hence it comes about that the sole author who discusses the build of the patch states that it consists of a fine black powder. At first I also could not

manage to see anything but loose members, although I took it for granted that they must be connected with one another in some way; but at last I succeeded in getting several uninjured scales, by boiling them in a solution of potash. Thereby it was ascertained that each of such hairs, or scales, reaches a length of 0·27mm.-0·35mm. and a breadth of 0·004mm. The members, of which the scales consist, vary much in length (0·013mm.-0·054mm.) and in form. The lowest (fig. 19*d*, *g*) is always drawn out into a stalk which sticks into the wing-membrane, and the uppermost (fig. 19*a*, *c*, *f*) is usually smaller than the rest, and has a small blunted tip. The joints, *i.e.*, the points where they join, of the members vary in appearance according to the side from which they are viewed, sometimes they look like two small knots projecting outwards on each side and separated in the middle by a furrow (fig. 19*c*), sometimes one sees only one (fig. 19*b*), this latter case resulting certainly from the fact that one knob covers the other when viewed from the side. How the members are really connected, whether by a fitting of the knobs one into the other, or whether by a thread running through all the members, I have not been able to discover with certainty. The upper surface, where the androconia are fixed, appears, on the denuded wing-membrane, quite opaque, on account of the closely compressed fastening-points. These are so close together that, on a moderate computation, there would be some 50000 to each square millimetre, and, as the surface on which they are fastened amounts to at least seven-eighths of a square mm., there would, therefore, not be less than about 44000 androconia. Now if we reckon the upper surface of each androconium at 0·0036 sq. mm., then they make altogether an upper surface of about 160 sq. mm., *i.e.*, a surface greater than that of the entire forewing. In colour the ♂ differs in its less size and distinctness of the yellow spots" (Aurivillius).

Genitalia.—Described and figured by Scudder (*Mem. Bost. Soc. Nat. Hist.*, iii., p. 350, pl. xi., figs. 10-11). Upper organ strongly arched, rather deeply sulcate above posteriorly; hook one-third the length of the centrum and slightly curved downwards; together with the centrum it is very broad at the base above, tapers roundly to a rounded apex, and is but little longer than broad; viewed from the side, the hook is nearly equal, the apex pointed beneath; lateral arms equal, cylindrical, tapering a little at the tip, not very widely separated from the centrum at their base, curving slightly upward, of equal length with the hook. Clasps about twice as long as broad, extending fully as far back as the upper organ, narrowing pretty regularly from the base, the upper margin incurved and deflexed, the posterior border rounded, extending beyond the apical tooth, and of a somewhat ragged outline; the preapical tooth is somewhat longer than the apical, but is incurved to such a degree as to appear of the same length on a lateral view; otherwise they are both nearly straight, upturned and narrowly separated by a very deep rounded excision; the irregularly serrated lamina supporting the inner anterior edge of the apical tooth possesses five or six slight serrations, and the lamina terminates abruptly opposite the anterior edge of the preapical tooth. [The appendages of the northern form, *catena*, seem to differ from those of the normal type only in sometimes having the preapical tooth no longer, or but very slightly longer, than the apical, and in that the two teeth are always separated by a slightly wider interval than in the

normal form, approaching in this respect *nevada*, and departing more widely from *manitoba*.]

Variation.—This is probably one of the most interesting species, from the point of view of variation, in the superfamily. From the limited standpoint of any particular country it would be considered a non-variable species, but so wide is its distribution throughout the Palæarctic and Nearctic areas, and so widely different its environment both as regards latitude and altitude, that minor variations have become more or less fixed in certain districts, and these have been largely described as distinct species by various authors. Within the limits of the Nearctic area this variation is very considerable, and more or less valid reasons have been brought forward for considering the American forms specifically distinct. This view, however, is not generally accepted, and the few American examples in the British Museum collection would not lead us to allow them distinction as species. In our later considerations of the forms that have been described, we shall separately consider the Palæarctic and Nearctic races. Of the general variation of the species, Oberthür notes (*Etudes d'Ent.*, xx., pp. 38-39) that the species varies considerably. On August 10th, 1895, it was in great abundance on the sand-dunes of Miel-Pot, between St. Malo and Cancale, and among others, a ♀ was captured with the apex of hindwings a "gris de lin" tint instead of the ordinary greenish-yellow; at the same place a ♂ was taken in which the white spots on the underside were much reduced, and others in which they were tinged with yellow. Among specimens from various localities, Oberthür further observes that he has examples from Savoy similar to the *catena* from Siberia; others from the Taurus, where the race is very bright and clear both on upper- and underside, etc. Dealing with the general variation of the upperside tints, based on the European specimens examined, we think the following covers the more usual forms:

1. Bright fulvous, almost unspotted (slight traces only towards apex of forewings); usual marginal border almost obsolete=ab. *clara*, n. ab.
2. Bright fulvous, marginal border fuscous, spotting on fore- and hindwings faint=ab. *intermedia*, n. ab.
3. Bright fulvous, marginal border and basal area fuscous, spotting pale and conspicuous=*comma*, Linn.
4. Ground colour suffused with fuscous, the fulvous restricted to the angulated row of spots and discal cell on forewings; and to the transverse row of spots and discal spot on hindwings=ab. *suffusa*, n. ab.
5. As in 4, but the spots yellowish, even whitish towards apex of forewings= ab. *pallidapuncta*, n. ab.
6. Almost entirely fuscous, spots much reduced on forewings, almost absent on hindwings=ab. *extrema*, n. ab.

Pathological aberrations, in which the pigment partially fails, and the wing, or part of it, becomes pallid, sometimes occur. We have four such, two ♂ s in which the left hindwing is pale, one ♂ in which both hindwings are pallid, and a ♀ the left hindwing pallid; the latter has a large pallid patch also on the underside of each forewing at anal angle, not noticeable on upperside. Parsons records (*Zool.*, 1862, p. 8204) that, in early September, 1862, he captured, at Aylesbury, an example with its forewings milk-white, the hindwings of a delicate green colour, the silvery spots of the underside shining through like gold. In Britain the common ♂ form appears to be that noted above as the type, whilst the ♀ is dimorphic, one form coloured correspondingly with the type, the other ab. *suffusa*. Occasional ♂ s, however,

lean distinctly to the *suffusa* type. Oldaker notes that, at Ranmore, some specimens are very light, others quite dark. Raynor observes (*in litt.*) that he has a ♂ from North Kent with the outer margins of fore- and hindwings much clouded with black and the androconial streak much intensified; he has also a ♀ from North Kent with the central areas of forewings and hindwings brightly fulvous, giving the whole insect a very light appearance. It would appear that the range of variation in Britain occasionally reaches ab. *intermedia* and ab. *pallida-puncta*, but, possibly, the extreme pale form ab. *clara*, and the extreme dark form ab. *extrema*, are only frequently to be met with in low latitudes and high altitudes respectively, although an occasional pale British one comes very near *clara*, *e.g.*, we have two ♂s from Cuxton nearly of this form. On the underside the European forms vary in the colour of the hindwings and apex of forewings from bright orange-yellow, through yellowish-grey, grey, greenish-grey and bright green; some of the greyish and greenish forms have the anal area of the hind-wing quite orange or orange-yellow, by contrast with the rest of the surface, as in *Adopaea flava*. The white spotting, too, varies considerably, not only in tint which extends from pure snow-white edged with dark to increase the intensity of the white, to a yellow almost lost in the ground colour and markedly obsolete (=ab. *flava*), but also in size and the amount of their separation. It is to be noted also that, as a rule, the races that tend to have the ground colour of the underside of the hindwings yellow, also tend to have yellow spots, blending more or less with the ground colour, whilst those that tend to green get intensely white spots, often conspicuously edged with black. The outer of the white spots on the underside of the hindwings, too, are sometimes united into a large zigzag mark(=ab. *conflua*, n. ab.); and it is very common for the three forming the lower part of the curve to be so united, the others remaining separate. Oberthür figures and describes (*Etudes d'Entom.*, xx., pl. vi., figs. 85-86, p. 38) two ♂ specimens (1) One with the hindwings beneath, having the usual eight or ten ordinary submarginal and basal spots united into one, so that only a pale yellow shade remains in the centre of the white blotch; taken at Sologne=ab. *juncta*, n. ab., and (2) One in which the normal white spots are obliterated on the underside of the hind-wings, and at the apex of the forewings by being suffused with black scales, only one small clear central whitish spot remaining in the centre of the inferior wings; believed to have been taken at Gavarnie =ab. *centripuncta*, n. ab. The upperside of the first is normal, that of the second is very dark. It is very rare that so completely united a form as ab. *juncta* occurs. More frequently, as noted above, the outer spots are united into a long zig-zag series, the central spots remaining free (=ab. *conflua*). Steinert notes an aberration in the "Seiler coll.," in which, on the underside of the hindwings, the cells are filled up with white to twothirds of the length, the white reaching furthest in cell 5. Moeschler observes (*Stett. Ent. Ztg.*, xv., p. 224) that ♀s from south Russia have most of the spots on the underside of the hindwings bordered with deep black, as well as the spots at the apex of the forewings.

The chief Palæarctic races divide into three groups—(1) The "pale" or "*clara*" group, tending to clear, bright, yellow ground-colour, passing through var. *pallida* (southeastern lowland form), var. *flava* (southeastern-Europe mountain form), and var. *dimila* (south Asiatic mountain form).

(2) The "dark" or "*suffusa*" group, tending to deep, dark, fuscous colours, and passing through the type (lowland European form), var. *catena* (high latitude form), var. *alpina* (European mountain form). (3) The "large" or "eastern" group, of large size, otherwise similar to 2, and passing from var. *florinda* (eastern lowland form), to var. *mixta* (central Asiatic mountain form). We deal with these groups separately.

THE "PALE" OR "CLARA" GROUP.

α. var. (et ab.) *flava*, Tutt, "Brit. Butts.," p. 129 (1896).—The usual white spots of the underside of the hindwings of a yellow hue, almost identical with the ground colour of the wings beneath.

This is a very rare British aberration, but occurs occasionally, especially in hot summers, and is also recorded by Oberthür from the Brittany coast at Miel-Pot, between St. Malo and Cancale. It appears to be typical, however, of warm mountain valleys in southeastern Europe. At Mendel Pass, in the Tyrol, it is quite a racial form, most of the specimens having the spots yellow, although some have them distinctly white. The form, too, is not infrequent at Simplon.

β. var. (et ab.) *pallida*, Staud., "Cat.," 3rd ed., p. 92 (1901). *Comma*, Staud., "Hor. Soc. Ent. Ross.," xiv., p. 295 (1879).—Pallidior, præcipue subtus; alæ posteriores subtus sæpius albovenatæ. Syria, Taurus; Western Kurdistan, Pontus (trans.), Sicily, Greece et Sarepta (ab. ?) ("Cat.," 3rd ed., p. 92).

Staudinger notes (*Hor. Soc. Ent. Ross.*, xiv., p. 295) that, on July 26th, Emil found the first specimen on the Caraman, and that afterwards it was not rare on the high tableland of Jeniheui, on August 11th, when a number of fresh specimens were taken. They vary slightly from the German examples by the colour being rather paler brown above, and more yellowish beneath; besides this, the white row of spots beneath is more obliterated, suffused with yellowish, and in one male almost completely absent. Staudinger adds that Mann had already met with single specimens near Brussa in June and July, and that Lederer took it in July on the Bosz-dagh; these were paler than German specimens. As Kindermann also took a very pale variety of *comma* in the Lebanon, Staudinger observes that it is almost certain to occur still further south in Asia Minor. Two Grecian examples (♂ and ♀) in the British Museum collection are very pale, but a third Grecian one (apparently belonging to the same set) is of a quite dark colour. Of two in the same collection from the Lebanon, of quite a bright fulvous on the upperside, the ♂ has forewings with hardly a trace of the usual darker marginal area, which is almost of the same bright tint as the rest of the wing; the usual upperside spots absent, except a trace of the two pairs of small dots nearer the apex; the hindwings unicolorous; whilst the ♀ has the two pairs of apical spots rather larger. The underside of the hindwings of the ♂ is very yellow with white spots, that of the ♀ has a more washed-out appearance with the spots united into a long zigzag mark.

γ. var. *dimila*, Moore, "Pr. Zool. Soc. Lond.," p. 576 (1874); Leech, "Butts. China," p. 595, pl. 41, fig. 12 (1893-4); Staud., "Cat.," 3rd ed., p. 93 (1901).—Allied to *P. comma*, ♂ and ♀. *Upperside:* testaceous; exterior border broadly fuliginous-brown; apex of forewing brownish-testaceous. Cilia whitish-testaceous; forewing with a series of small yellow apical spots; male with an oblique silvery-lined black streak below the cell; hindwing with a yellow spot within the cell, and a curved discal series of four quadrate spots. *Underside:* forewing pale testaceous; apical spots as above; hindwing with basal portion greenish-brown; three prominent white subbasal spots disposed above, below, and at end of the cell; a curved

discal series of six quadrate white spots. Exp. ♂ 1⅜ inch, ♀ 1⅜ inch. Habitat: Runang Pass, Busahir (southeast side about 13000 ft.), captured by Captain H. B. Hillard (Moore).

This is the southern Asiatic mountain form, smaller, paler, and of a somewhat washed-out appearance. Types in the British Museum collection we have noted as being "fulvous; rather pale on the upper- and undersides, the underside of hindwings yellowish with marked square white spots." Staudinger seems to have only known the insect from description, for he writes, "Praecedenti (*mixta*) similis, alis posterioribus supra obscurioribus; subtus maculis albidis non bifurcatis, nigro-cinctis. Northwest Himalayas, southwest China." Probably he only had Chinese specimens, which may differ from the Indian ones; at any rate the marked pallid coloration of the type is not brought out in his description. Leech says that a specimen agreeing with the Indian form has been sent from Tu-chien-lu in Western China.

### The "dark" or "suffusa" group.

α. The central European type.

β. var. (et ab.) *catena* [(Keit.), Heydrch., "Lep. Eur.," p. 18 (1851);], Staud., "Stett. Ent. Zeit.," p. 357 (1861); "Cat.," 2nd ed., p. 35 (1871); 3rd ed., p. 92 (in part) (1901); Rühl, "Pal. Gross-Schmett.," p. 647 (in part) (1895). *Cattena*, Meyer-Dür, "Schmett. der Schweiz," p. 217 (1852). *Cataena*, Lang, "Eur. Butts.," p. 354 (1884).—Keitel sent specimens from Swedish Lapland, under the name *catena*, which Heydenreich inserted in his *Catalog* under this name. It appears unnecessary, however, to give it a special name, as among the northern specimens are many similar to those from other countries (Staudinger, *Stett. Ent. Zeit.*, 1861, p. 357). However, Staudinger diagnosed the form (*Cat.*, 2nd ed., p. 35) as: "Alis posterioribus subtus viridibus, maculis albidioribus nigro-adumbratis. Lapland, northeast Siberia and Sajan district, Altai, high Alps," etc. Finland: Solovetsk, Kaschkarantsa, Tschavanga (Edgren). Norway: Arctic region of Norway—Dovre, Bossekop, Talvik (Schöyen), Finmark (Staudinger), Ose, Hægstoil, Kaafjord, Sopnes, Nordreisen (Strand). Sweden: Lapland (Keitel).

Staudinger notes (*Stett. Ent. Zeitg.*, 1861, p. 357) that the examples from Finmark differ little on the upperside, although rather more on the underside, from the specimens of middle and southern Europe. In the northern examples, the pale spots on the underside of the hindwings are almost white with a deep black edging, and are frequently united; they are, therefore, more conspicuous in the deeper green ground colour, which is also more or less mixed with black. Keitel sent out similar examples from Swedish Lapland, under the name of *catena*, and this name was quoted by Heydenreich in his *Catalogue*. A special name, however, hardly seems to be justified, as one not unfrequently finds, among the northern examples, specimens which agree with those from other countries. According to Wocke (*Jahresberichte Schles. Gesell.*, etc., 1881, p. 200) this form is, except for the underside of the hindwings, paler than the ordinary typical form of the German plains, and this is borne out by the Finmark examples in the British Museum collection. Meyer-Dür says (*Schmett. der Schweiz*, p. 217) that he fails to find any distinction between the Lapland specimens and others from the Alps, except that the ground colour of the underside of the hindwings and of the borders of the forewings is of a rather darker olive-green than the examples from the Grimsel, but the specimens from the lowlands have these parts of a brilliant light, or yellow, green. This appears to be the case, for there are many Alpine examples of quite ordinary appearance on the upperside, but with well-marked underside, especially of the hind-

wings, both as to the green ground-colour and dark-margined white spots, which cannot be said to differ from the Finmark form in any appreciable manner. The Finmark specimens in the British Museum collection are in no wise melanic; they are brown, rather pale (paler than the British form on the upperside). The very dark Alpine examples appear not to be the same as the extreme northern form.

γ. var. *alpina*, Bath, "Entom.," xxix., p. 21 (1896); Staud., "Cat.," 3rd ed., p. 92 (1901); Wheeler, "Butts. Switz.," p. 9 (1903). *Catena*, Frey, "Lep. der Schweiz," p. 55 (1880); Wocke, "Jahresber. Schles. Gesell.," lviii., p. 200 (1881); Kane, "Eur. Butts.," p. 148 (1885); Rühl, "Pal. Gross-Schmett.," p. 647 (in part) (1895); Tutt, "Brit. Butts.," p. 129 (1896); Wheeler, "Butts. Switz.," p. 9 (1903).—A little larger and possessing a melanochroic tendency, the dark markings being more intense, and occupying more space at the expense of the orange-coloured blotches and spots. At 6000ft. elevation in the Bernese Alps—on the Wengern, Scheideck Pass (Bath). Austrian Alps: high in the Brenner district (Galvagni). German Alps: Rhine Provinces—Stiftswald, in Kaufungen, &c. (Knatz). French Alps: general, high up in the Savoy and Dauphiny Alps—Le Lautaret, &c. (Tutt). Italian Alps: Piedmontese valleys at 5000ft. to 7000ft. (Tutt), Certosa di Pesio (Norris). Swiss Alps: general, above 5000ft. (Tutt). Hungarian Alps: Eperies (Aigner).

The real difference between the examples from high latitudes and high altitudes appears to be considerable, yet the European lepidopterists for many years united the specimens from Finmark and the high alps under the name of *catena*, and, as such, attention had been drawn to the tendency of the Alpine specimens to a darker upperside and greener underside coloration. The marked differential feature appears to be, as Wocke has already pointed out, that the Finmark specimens are as pale (or even paler) on the upperside as the lowland forms, with a slightly washed-out appearance in the specimens in the British Museum collection, whilst the Alpine examples in both sexes, but especially in the females, tend to become very dark in the ground-colour, the pale spots strongly contrasting therewith. Thus, in 1880, Frey observed that the high mountain examples were larger and darker, especially in the females, and that such were taken in the highest parts of the Valais, Engadine and Tyrol up to 7000 ft. and 7500 ft. Wocke, in 1881, observed that it was common between Trafoi and Franzenshöhe. He agrees with Frey that the upperside is generally much darker than the form from the plains and usually rather larger, whilst he further states that, in some examples, the green colour is still more intense than in the Lapland specimens, whilst the white spots are just as sharply defined; the forewings, also, much darker beneath, blackish-green at the base and in the apical area, and the brownish-yellow ground colour only present in the middle of the wing, growing paler from the costa towards the hinder angle. Staudinger diagnoses the form as "major, obscurior plerumque vix distinguenda."

### The "large" or "eastern" group.

α. var. *florinda*, Butler, "Cist. Ent.," ii., p. 285 (1878); Staud., "Cat.," 3rd ed., p. 93 (1901). *Repugnans*, Staud., "Rom. Mém.," vi., p. 211 (1892); Rühl, "Pal. Gross-Schmett.," p. 647 (1895); Tutt, "Brit. Butts.," p. 129 (1896).—*Pamphila florinda*, ♂, ♀. Above like *P. comma*, but deeper in colour; below altogether redder in tint, with scarcely a trace of pale spots, only two or three being indistinctly traceable on the secondaries; the veins also not tipped with black. Expanse of wings, ♂ 1 inch 6 lines, ♀ 1 inch 5 lines. There is the same difference between the sexes as in the European insect, the male being tawny with purplish-brown borders and grey streaked oblique black band, the female purplish-brown with the usual straw-yellow or ochreous spots. The position of the

species will be between *P. comma* and the *P. sylvanus* of Japan (Butler), Central Japan, ? Yesso, Corea, Gensan (Leech).

Butler's types in the British Museum collection, a ♂ and ♀, are larger in size, well-coloured, inclining to being rather darker than the European type, and present what we might assume to be a richly-coloured, well-developed, lowland race of the form described from the Jhela Drosh (*infrà*). Staudinger writes (*Rom. Mem.*, vi., p. 211) that *repugnans* had been found at Kidso (Schrenk), rarely near Nik (Graeser), a ♀ at Chab (Hedemann), at Baran (Dörries), also both sexes were taken by Dörries in the Sutschan district. The principal differences between this form and *U. comma* are (1) The light spots on the underside of the hindwings are very small and in part disappear, being almost completely covered by the yellow-green ground colour. (2) The ♂s on the upperside are very dark on the outer margin in which the pale apical spots stand out conspicuously; although the ♀s are hardly darker than those of typical *comma*, these spots on the upperside are still conspicuous. The northern *catena* on the underside forms the greatest contrast with *repugnans*. Staudinger further notes that he has a ♀ *comma* from Berlin closely resembling *repugnans* on the underside, whilst from Greece, he has specimens with brightly marked undersides, more striking even than in *catena*. Herz caught large examples of *U. comma* in Corea, which, however (*teste* Fiesen), resemble the European specimens. He also captured very large ones of a form, closely resembling on the upperside *U. comma*, but which, on the underside, are almost without markings and which may be considered as a sub-variety of *repugnans*. Staudinger adds that he would be inclined to consider them a form of *sylvanus*, were it not that Herz caught in the same locality numerous typical examples of *sylvanus*. Here (*op. cit.*) Staudinger refers *florinda* to *Augiades sylvanus*, but later (*Cat.*, 3rd ed., p. 93) notes it as doubtfully *comma*. He writes: "var. *? florinda*. Alis supra fasciis latis marginalibus obscurissimis; alis posterioribus subtus maculis paucis [subnullis] parvis subalbidis. Sp. div. an *sylvani* var. Ussuri, Corea, Japan, North China." Rühl notes that this insect is "on the upperside much more like the type than on the underside, since on the hindwings the pale underside spots become very small, and, in fact, disappear, being almost wholly covered by the yellow-green ground colour." Rühl further notes that, to the north of Pekin, very large specimens occur, which, on the upperside, are very like *comma*, but, on the underside, are almost without markings, and are probably to be considered as a subvariety of *repugnans*, Staud. (=*florinda*, Butl.). Leech says that the specimens from near Pekin that were taken by Herz, appear to be *florinda*, and that a long series shows that the latter is a form of *comma* and not of *sylvanus*, which it much resembles on the underside. He also notes that the type of *mikado*, Mabille (MS.), is a very worn specimen of *florinda*.

β. var. *mixta*, Alph., "Hor. Soc. Ent. Ross.," p. 432 (1881); Staud., "Iris," v., p. 340 (1892); Rühl, "Pal. Gross-Schmett.," pp. 648, 828 (1895); Tutt, "Brit. Butts.," p. 130 (1896); Staud., "Cat.," 3rd ed., p. 92 (1901). *Lato*, Grum-Grsh., "Hor. Soc. Ent. Ross.," xxv., 459 (1890). *Latro*, Rühl, "Pal. Gross-Schmett.," i., p. 647 (1895); Tutt, "Brit. Butts.," p. 129 (1896).—♂ 33mm., ♀ 36mm.-36·5mm. Var. major, supra obscurior; subtus viridior, maculis albis magnis, distinctissimis. Larger than the European type, with the outer part of the wings darker, resembling, in this respect, certain examples of var. *catena*, Stdgr., from Lapland. The hindwings greener and darker on the underside, with the white spots not black-margined, as is often the case in the typical form and its varieties.

Only three examples were captured on the Jouldousse, in the Thian-Shan, in July. There is no doubt that the examples belong to a variety which, beyond its shape, presents a combination of characters peculiar to other local forms. The examples were captured at from 8000ft.-9000ft. elevation (Alphéraky).

This appears to be, without doubt, the Central Asian dark mountain form, not, perhaps, unlike many Central European examples. Alphéraky is wrong, however, in making *catena* a dark upperside form, as has already been shown. Rühl notes (*Pal. Gross-Schmett.*, i., p. 648) *mixta* as being the opposite of var. *repugnans*, since the underside much resembles the type, whereas the upperside is as light as in light *Augiades sylvanus*; it is easily to be distinguished from the latter by the silver-gleaming, comma-marks, etc. We cannot understand these remarks, nor Rühl's further notes, which entirely contradict Alphéraky's original description quoted above, and misled us into our remarks (*Brit. Butts.*, p. 130). Specimens in the British Museum collection from Jhela Drosh, in 1898, and others from the Shishi Kah Valley, Chitral, taken in July-August, 1891, at from 9000ft.-14000ft. elevation, undoubtedly belong here. Those from the first locality are very fine in colour, in both sexes, a deep fulvous-brown with dark margins, the basal areas of all the wings, to beyond middle, of uniform tint throughout, with the ordinary row of spots, however, nearly obsolete, owing to their similarity with the surrounding colour. The underside of hindwings greenish; the anal area cut off sharply and yellowish, the spots of hindwings very white (in one united = ab. *mixta-conflua*), as are also those at apex of forewings. Those examples from the higher mountains are more fuscous on the upperside, especially on the outer margin, and the upper spots of the transverse row across forewing are, in the ♀ s, paler. These latter agree absolutely with the *lato* of Grum-Grshimailo (*Hor. Soc. Ent. Ross.*, xxv., p. 459), diagnosed as follows: "Supra alis multo obscurioribus, nigro-fuscis, basin versus fulvescentibus, maculis fulvis; subtus anticis fulvo-rubescentibus, ad marginem internum pallidioribus, areis basali et interna nigris, costa apiceque viridibus, maculis quinque apicalibus flavis, duabus disci dilute fulvis, extus late nigrescenti adumbratis; posticis viridibus, ad angulum analem fulvis, maculis quadrangularibus, magis a margine externo distantibus, albis. Fimbria flavida. Antennis obscurioribus. Specimen unicum in montibus Dshachar collectum." We quite agree with Staudinger in uniting *lato*, Gr.-Gr., with *mixta*, Alph. Staudinger diagnoses it (*Cat.*, p. 92) as "alis anterioribus supra extus obscurioribus, alis posterioribus subtus viridibus distinctissimo albo-maculatis. From Thian-Shan, Fergana, southwest Pamirs, ? eastern Nan-Shan mountains, southeast Siberia, Kentei."

### American forms of Urbicola comma.

Students of the American forms of *U. comma* must study Scudder's article, "The species of the lepidopterous genus *Pamphila*" (*Mem. Bost. Soc. Nat. Hist.*, ii., pp. 341 *et seq.*, pl. x-xi). Scudder inclines to the view that there are a number of closely-allied, distinct American species allied to *U. comma*. His figures, descriptions, etc., suggest the contrary, and we can only assume that he had altogether too little European (and American) material for comparison. Speyer's material, too, appears to have been of the scantiest, and it appears incredible that the British Museum collection is absolutely wanting in types of the American forms—with the exception of three specimens

labelled "*colorado*, Scudd." (a ♂ and ♀ of which are distinctly of Central European form), and three labelled "*manitoba*, Scudd." [a ♂ and ♀ of which labelled "Arctic America—Rapids of the Drowned. June 30th, 1892 (Taylor)," are practically indistinguishable from Finmark specimens]. Scudder's tables (*op. cit.*, pp. 344-6) are most interesting, and are three in number, *viz.*, (1) A table to determine the ♂s drawn from the ornamentation of the wings. (2) A table to determine the ♀s drawn from the ornamentation of the wings. (3) A table to determine the ♂s drawn from the abdominal appendages. These tabulations, so far as they relate to the forms of *U. comma*, read as follows:—

TABLE TO DETERMINE THE MALES OF THE NEARCTIC FORMS OF U. COMMA; DRAWN FROM THE ORNAMENTATION OF THE WINGS:

| | |
|---|---|
| 1. Uppersurface of hindwing almost wholly tawny, with a very narrow dusky, or dark brown border .. .. .. .. | 2. |
| 1. Uppersurface of hindwings largely obscured with dusky, or with a very broad dusky or dark brown border .. .. .. | 3. |
| 2. Less than 36mm. in expanse; undersurface of hindwing distinctly marked with an irregular mesial band of partially connected spots .. .. .. .. | *nevada.* |
| 3. Discal dash of uppersurface of forewings followed, in the lower median and medio-submedian interspaces, by a narrow belt of blackish scales .. .. .. .. .. .. .. | *sylvanoides (columbia).* |
| 3. Discal dash of uppersurface of forewings not followed by any row of dusky scales along its lower edge .. .. .. | 4. |
| 4. Undersurface of hindwings with an irregular mesial band, composed of distinct, large, squarish, nearly uniform spots .. .. .. .. .. .. | *juba.* |
| 4. Undersurface of hindwings with an irregular mesial band composed of distinct, small or rather small, spots, seldom uniform .. .. .. .. .. .. | 5. |
| 5. Band crossing undersurface of hindwings bent at an angle of 50°, the band much constricted near the angle .. .. .. | *colorado.* |
| 5. Band crossing undersurface of hindwings bent at an angle of 60° to 75°, the spots near the angle only a little, if any, smaller than the others .. .. .. .. .. .. .. | 6. |
| 6. Each of the spots forming the mesial band of the undersurface of the hindwings distinct, often narrowly edged on the outer and inner edges with black, the ground of the wing almost always rather heavily flecked with dark green .. .. .. .. .. | *comma.* |
| 6. The spots of the mesial band of the undersurface of the hindwings confluent, or nearly so, almost never and then but slightly edged with black, the ground of the wing but slightly flecked with not very dark green .. | *manitoba.* |

TABLE TO DETERMINE THE FEMALES OF THE NEARCTIC FORMS OF U. COMMA; DRAWN FROM THE ORNAMENTATION OF THE WINGS:

| | |
|---|---|
| 1. The paler markings of the undersurface of the wings, white or silvery-white, conspicuous .. .. .. .. .. | 3. |
| 3. Forewings with semi-hyaline spots in the median interspaces .. | *sylvanoides (columbia).* |
| 3. Wings without trace of hyaline spots .. .. .. .. | 4. |
| 4. Ground colour of undersurface of hindwings greyish-green .. .. .. .. .. .. .. | 5. |
| 4. Ground colour of undersurface of hindwings olive or yellow-green .. .. .. .. .. .. | 6. |
| 5. A large species; markings on undersurface of forewings, below the middle median nervure, generally very ill-defined; hindwings slightly but distinctly produced next the inner portion of the outer margin; band of undersurface of hindwings broad and usually connected; inner area of same surface | |

tinged distinctly with buff; distinct blackish patches at the base of the median interspaces on the upper surface of the forewings .. .. .. .. .. .. .. .. *juba.*

5. A rather small species; markings on the undersurface of the forewings, below the middle median nervure, generally well-defined, at least above; hindwings with a scarcely perceptible fulness to the outer margin next the inner border; band of undersurface of same wings moderately broad, often broken; inner area of same surface slightly paler than the rest, but scarcely tinged with buff, faint, dusky patches at the base of the median interspaces or the upper surface of forewings; or, usually, these parts are no darker than the surrounding field . *nevada.*
   6. Mesial band of the undersurface of hindwing bent at an angle of 45° or 50°; spots of this band generally vivid, approaching the outer margin of the wing so closely in the interspace beyond the cell as to be removed from it by less than their own width .. .. .. *colorado.*
   6. Mesial band of the undersurface of the hindwings bent at a right angle, or a little less than a right angle, the spots generally not very vivid, separated from the outer margin in the interspace beyond the cell by at least their own width, and ordinarily by much more than that .. .. .. .. .. .. .. 7.
7. Spots in the interspace beyond the cell generally smaller than the others which make up the mesial band of the undersurface of the hindwings, giving the band an irregular appearance; spots of the lower portion of the band generally confluent; the V-shaped spot, traversing the cell near its extremity, very seldom crossing the median nervure to the medio-submedian interspace, and not enlarged there; basal half of fringe on the hindwings, as seen beneath, generally not at all, or very inconspicuously, interrupted with dusky at the nervure tips .. .. .. .. .. .. .. *manitoba.*
7. Spots of the mesial band on the undersurface of the hindwings pretty uniform in size, those of the interspaces beyond the cell seldom any smaller than the others, so the band has a more regular appearance than in *P. manitoba*; spots of the lower portion of the band distinctly marked, sometimes even independent; the V-shaped spot traversing the cell near its extremity always crossing the median nervure to the medio-submedian interspace and enlarged there; basal half of fringe on the hindwings as seen beneath, generally conspicuously interrupted with blackish at the nervure tips .. .. .. *comma.*

TABLE TO DETERMINE THE MALES OF THE NEARCTIC FORMS OF U. COMMA: DRAWN FROM THE ABDOMINAL APPENDAGES.

1. Hook and lateral arms of upper organ separated by a deep cleft, about half the length of the horizontal portion of the organ; hook slender, as viewed from above; clasps not extending nearly so far back as the upper organ .. .. .. .. 2.
1. Hook and lateral arms of upper organ separated by a slight cleft, not quarter the length of the horizontal portion of the organ; hook very stout as viewed from above, clasps extending almost or quite as far back as the upper organ .. .. 3.
   2. Hook and lateral arms nearly parallel, and but slightly separated .. .. .. .. .. .. .. *nevada.*
3. Clasps, when viewed exteriorly, with two conspicuous superior apical teeth.. .. .. .. .. .. .. .. 4.
3. Clasps with but one conspicuous apical tooth .. .. .. { *sylvanoides* (*columbia*).
   4. Apical tooth of clasp equally separated from each other from base to summit; clasp itself much broader at base than elsewhere, about twice as long as broad .. 5.
5. Apical teeth of clasp very closely approximated, often appearing at first sight as if single; anterior inner edge of apical tooth but little produced as a slightly and bluntly toothed lamina;

a distinct notch in advance of the preapical tooth; posterior border of clasp subangulated, scarcely produced beyond the apical tooth.. .. .. .. .. .. .. .. 6.

5. Apical teeth of clasp less closely approximated, readily distinguishable; anterior inner edge of apical tooth produced as a sharply and distinctly denticulate lamina; no distinct notch in advance of the preapical tooth; posterior border of clasp rounded, produced considerably beyond the apical tooth .. 7.

6. Apical teeth of clasp very closely crowded together, the preapical slightly the longer; lamina continuing the inner anterior edge of the apical tooth moderately high .. .. .. .. .. .. .. *colorado.*

6. Apical teeth of clasp not so closely crowded together, and of equal length; lamina continuing the inner anterior edge of the apical tooth, very low and inconspicuous *manitoba.*

7. Posterior margin of clasp smooth, rounded; inner anterior edge of apical tooth forming a denticulate lamina, more nearly transverse than horizontal in its relation to the clasp, the largest denticulations above, the lamina terminating gradually, opposite the posterior border of the preapical tooth .. *juba.*

7. Posterior margin of clasp ragged and irregular; inner anterior edge of apical tooth forming a denticulate lamina, more nearly horizontal than transverse in its relation to the clasp, the denticulations as large below as above, the lamina falling abruptly off at its anterior extremity opposite the anterior border of the preapical tooth .. .. .. .. .. *comma.*

Speyer, on confessedly slender material, writes (*Can. Ent.*, xv., pp. 141 *et seq.*) an interesting paper on the American forms of *Urbicola comma.* With specimens of *nevada*, *manitoba*, *colorado*, and *juba* before him, as well as a supply of *comma* from northern and middle Europe, and eastern Asia, including Amurland, Amasia, and Lebanon from Staudinger, and comprising many interesting specimens differing very materially from the central European type, he notes that none were actually identical with an American form, although occasionally an approach occurs, but adds that for the most part, their variations from the central European type lie in a different direction than toward the American forms. They afford, however, ample evidence of the great variability of the species under the pressure of various climatic and other external conditions. In the structure of the body, and, in the form of the antennæ, palpi and legs, apparently no difference exists between Scudder's species mentioned above and *U. comma.* The coloration of the underside varies considerably, however, but offers no available characteristics for the separation of individual forms; sometimes the secondaries are distinctly veined, whilst, in connection with the bright or dull colours of the square spots, their extraordinary variation in size, the presence or absence of their black border, no exact forms can be defined, as all these pass into each other by imperceptible gradations. Having separated *juba* as a well-marked form, he lumps *manitoba*, *colorado*, and *nevada* together to compare with *comma*, and states that, in the size, shape, colour, and markings of the upperside of the wings, as well as in the form of the discal stigma, he finds no variation from *comma*, but adds that none of the compared American insects entirely agree with European and Asiatic *comma* in the shape and arrangement of the white spots on the underside of the secondaries. He says that "the interrupted row of spots beyond the middle of the secondaries in typical *comma* consists, as is well-known, of six more or less quadrangular spots, separated by the nervules, two of which, often somewhat larger and oblong in shape,

stand below the costal margin in cellules 7 and 6, one (a double spot) between nervules 4 and 6 opposite the middle cell, and also one in cellules 3, 2, and 1, which last usually has an appendage turned towards the inner angle. These spots form two rows, which meet at an angle of from 65° to 90°, in the vertex of which stands the spot between nervules 4 and 6; the three upper spots always, and the three lower ones usually, forming a straight row with the spot standing in the vertex of the angle; sometimes these lower spots stand somewhat out of line and farther from the spot in the vertex; the size of the spots varies in individual specimens very considerably, sometimes they become so small that they stand widely separated from each other, sometimes so large that they entirely meet; rarely one of the spots is wanting (that in cellule 1 or in cellule 7). In the American specimens, on the other hand, the greatest variation in the form, size, number, and arrangement of these spots is presented (even in such as Scudder includes in the same species *colorado*), and not one of these shows the form and arrangement of the spots as described in typical *comma*. Even the two sexes in these forms seem to differ much more strongly than in *comma*, which shows scarcely any recognisable difference between ♂ and ♀, except that in the latter the spots are usually larger than in the ♂.* A second noteworthy difference between European *comma* and its American congeners is that, in the former, the fringes on the underside are always spotted with fuscous, at least (in secondaries) on their lower half, while in the American forms the fringes are, as a rule, unspotted. Yet this distinction is not invariable, for two of the specimens submitted (a ♂ *colorado* and a ♂ *manitoba*) have spotted fringes. There exists then, so far as I can discover, only the difference drawn from the underside of secondaries, which, if it were constant, would suffice to separate the American forms from *comma*, but that it is constant seems to be somewhat improbable, on account of the very great variability which is shown in the shape, number, and arrangement of the square spots, and *juba* gives a direct proof that we cannot rely upon this feature. A second proof is furnished by Scudder's figures of *manitoba*, one of which (fig. 10) does not differ in any respect from many forms of European *comma* in the character of the rows of spots, while the remaining figures (and still more decidedly the two specimens I have) deviate therefrom. We also conclude from Scudder's descriptions that, in this point, *manitoba* can scarcely, if at all, be separated from *comma* by any constant difference." Two specimens of *sylvanoides*, Scudder, submitted to Speyer, were determined by him as not being *sylvanoides*, Bdv.,† and he considered the ♀ simply an unimportant aberration of *comma*, and the male with no differences sufficiently important to make him consider *sylvanoides*, Scudd., as anything more than a local form of *comma*. The result of these comparisons were summarised by Speyer as follows:—"That among the examples of Scudder's species submitted to me, not one is found which agrees

* This shows distinctly that Speyer must have been very poorly supplied with European material. The difference noted in the fringes, too, in the succeeding paragraph is very untrustworthy.

† Edwards says (*op. cit.* p. 148) that *sylvanoides*, Scudd., is the same as *columbia*, Scudd., the latter for a time thinking that his *columbia* was *sylvanoides*, Bdv., which latter species he called *sonora*, a quite distinct species.

perfectly with European *comma*, and, on the other hand, the existing differences appear to be of too little importance, and, above all, not sufficiently constant to make it possible on the strength of these to declare the American forms specifically different from *comma*. The latter is, in a high degree, under the influence of various external life-conditions, and is, as both the American and the Asiatic forms prove, a species varying in different directions. Whether any one of these local forms has already sufficiently established itself to be able to rank as a distinct species, others, who are equipped with more abundant material, will be able to decide with more certainty than myself."

Commenting on these conclusions, Edwards remarks (*op. cit.*, pp. 147 *et seq.*) that the differences in the underside spotting of *manitoba*, *colorado* and *nevada*, as regards shape and arrangement, are constant. As to the spotted fringes said to be constant in European *comma*, they are sometimes present, but not in all the forms under review, in *colorado* 1 ♂ and 1 ♀, in *manitoba* 2 ♀s were found with them, whilst no *nevada*, *columbia*, or *idaho* had them, but Edwards' material (like Speyer's) was very insufficient (scarcely half-a-dozen specimens in some instances). He considers the occasional presence of the fringe-spots in the American forms of this group, may be sufficiently accounted for on the theory that the European, Asiatic and American forms are of co-ordinate value, and inherited these spots from their common ancestor; in the American they have disappeared, but occasionally the character is recovered by reversion. He says that Scudder's types are distinct enough in the case of *manitoba*, *colorado* and *nevada*, and, he thinks, should be considered as so many species. Commenting on the fact that Speyer notices that in all these forms the two sexes seem to differ much more strongly than in *comma*, the differences noted, Edwards says, appear to be constant. Edwards enters into a criticism of Speyer's remarks on *sylvanoides*, Scudd. (= *columbia*, Scudd.), and compares the form with a ♂ and ♀ *comma*, falling back at last almost entirely on differences of underside colour, and differences in colour between the sexes (two markedly variable features in *comma*), as entitling it to specific rank. Without going further into the question of the actual value of the American forms, all of which, by the way, Dyar drops in his *List of North American Lep.* (1902), as varieties of *comma*, L., a conclusion with which our limited knowledge brings us into complete agreement, and, without attempting the difficult task of comparing them with the European forms, for which study we are altogether lacking in material, we give the following descriptions of the described American forms :—

*a.* var. *manitoba*, Scudd., "Mem. Bost. Soc. Nat. Hist.," ii., p. 351, pl. x., figs. 8-11, pl. xi., figs. 7-8 (1874); Speyer, "Can. Ent.," xv., p. 143 (1883); Edw., "Can. Ent.," xv., p. 147 (1883); Scudd., "Butts. New. Engl.," pp. 1646 *et seq.* (1889); Lyman, "Can. Ent.," xxiv., pp. 57-59 (1892); Dyar, "List North Amer. Lep.," p. 50 (1902).—This species is the most nearly allied to *P. comma* of all American species; the size of the two is the same, and the upper surface of the ♀ varies in each species to the same extent. There are no constant features of distinction in the upper surface of the ♂, although, in *P. manitoba*, the hindwings are usually devoid of the appearance of the spots on the under surface, which generally are faintly but exactly marked upon the upper surface in the European species. The under surfaces of the two species also resemble each other closely, and it is a little difficult to define in words the distinctions which are apparent. The ground colour inclines more to deep green in *P. comma*, and the mesial bent band of the hindwings is rather more uniform; in the ♂ it seldom departs from a certain

regularity of disposition, the spots being nearly equal, arranged in a line bent at a little less than a right angle, occasionally broken into spots, and sometimes with a narrow black bordering to the spots upon the inner and outer side. In the ♂ of *P. manitoba* the spots generally diminish in size toward the middle of the wing, and, from the greater approximation to the outer border (shown by the spot in the interspace beyond the cell), the band is bent at considerably less than a right angle; the spots are never bordered with black, at least in specimens I have seen. The ♀ of *P. comma* agrees very well with the ♂ of the same in its characteristics, only the band is somewhat broader, and, perhaps, more frequently made up of detached spots, while the ♀ of *P. manitoba* differs to a greater degree than its male, the spots showing greater tendency to become equal in size, to separate from each other, and even to become margined slightly with black; it is, therefore, less readily distinguished from this sex of *P. comma* than the males are. There is also great variation in the breadth of the band or the size of the spots, for, while usually larger than in the ♂ (as in most species), they are sometimes many times larger, and occasionally almost as small as in the most delicate-marked males. Of the genital armature, the upper organ is bent at a right angle in the middle and rounded, sulcated above, as in *P. comma;* the hook and lateral arms closely resemble those of *P. comma*, but are slightly shorter, the hook only about one-fourth the length of the centrum; the clasps a very little more than twice as long as broad, closely resembling those of *P. comma*, the posterior border is, however, smoothly rounded and not so protuberant; the teeth are of equal length, similarly incurved, and very narrowly separated by a very deep rounded excision, the lamina supporting the inner anterior edge of the tooth is very slight, having but one or two dentations, and then disappearing. It is a widespread species, having been taken in Colorado by Mr. Mead, about Pike's Peak (Edwards), on the shores of Lake Winnipeg by the late Mr. Kennicott and myself, by the late Mr. Crotch at Labache, and at Rivière du Loup by Mr. Couper. It occurs from the end of July to mid-September. Reaches across N. America, following the southern border of the Dominion of Canada from Quebec to Vancouver. More particularly a western species, following down the coast ranges to central California, and the Rocky Mountains as far as Colorado. Along the Pacific coast it has been found in Calavaros Co., Cal. (Brehens); near Truckee, Nev. (MacGlashan); Fort Klamath, Or. (Merrill); Washington Terr. (Edwards); Vancouver Isl. (Fletcher); Lake La Hache (Crotch); Pike's Peak, Manitou, Col., Regina (Fletcher); east coast of Lake Winnipeg (most northerly locality (Scudder); Nepigon, Sudbury (Fletcher); Rivière du Loup, nearly opposite mouth of Saguenay river (Couper). From end of July to mid-September (Scudder).

After examining Scudder's types of *manitoba*, Lyman notes (*Can. Ent.*, xxiv., p. 58) that one agreed exactly with var. *laurentina*, the others (from British Columbia and Colorado) were greener but did not agree with var. *assiniboia*, or approach the average of the Regina *assiniboia*, but Scudder considered that, on account of the close similarity of their markings, the latter must be a form of *manitoba;* of which, indeed, Smith showed the genital organs to be identical. He, however, further states that Scudder's description of *manitoba*, "the underside of the hindwings, except for the markings, almost uniformly greenish-yellow," in the *Butts. of New England*, would appear to refer rather to *assiniboia* than the less green specimens from British Columbia and Colorado.

*β*. var. *colorado*, Scudd., "Mem. Bost. Soc. Nat. Hist.," ii., p. 349 (1874); Spey., "Can. Ent.," xv., p. 143 (1883); Edw., "Can. Ent.," xv., p. 147 (1883); Dyar, "List Nth. Amer. Lep.," p. 49 (1902).—Upon its upper surface this species differs from *P. manitoba*, with which it agrees in size, in scarcely any other particular than the rather darker bordering in the ♂s and the more conspicuous transverse mesial band of the hindwings in the ♀s. Beneath, the ground colour varies from olivaceous to griseous-green, the mesial belt of the hindwings is peculiar for the manner in which it diminishes in width where it bends at the middle; it is apparently made up of three patches, a lozenge-shaped patch in the lower subcostal interspace; a rather broad belt, nearly uniform in width, but irregular in outline, crossing the median and part of the medio-submedian interspaces; and a similar belt, but only half as wide, crossing the interspace beyond the cell, its outer limit on a line with the outer limit of the previously mentioned belt, and its upper interior angle reaching toward the tip of the lozenge-shaped patch; these

spots are generally bordered narrowly with blackish. In the female, the spots are generally larger, more frequently parted, less regularly disposed, and occasionally accompanied by a spot in the upper subcostal interspace. The genital armature has the upper organ rather small, strongly arched, sulcate above posteriorly, the centrum, hook and lateral arms almost exactly as in *P. manitoba*. Clasps not large, yet extending as far as the upper organ, fully twice as long as broad, tapering pretty regularly, the posterior margin roundly angulated, the two teeth scarcely separated by a very deep, equal rounded excision, the preapical slightly the larger and more incurved, the apical followed within anteriorly by a rather stout but low lamina, furnished with one or two small tubercular dentations opposite the preapical tooth. This species has been taken in Colorado, about the Georgetown and South Park Roads, by Mr. Mead, and in Arizona by Lieutenant Wheeler's expedition (Scudder).

There are three specimens in the British Museum collection under this name: (1) A ♂ of particularly typical central European appearance on the upperside; the underside bright yellowish-green, with small, well-marked, clearly outlined, rather united white spots, also similar spots at apex of forewings. (2) A ♀ dark in colour, fuscous-brown, with rather pale yellow spots on upperside; the underside with the white spots larger, both on hindwings and at apex of forewings. (3) A worn ♀ from Colorado.

γ. var. *idaho*, Edw., "Can. Ent.," xv., p. 148 (1883); Dyar, "List Nth. Amer. Lep.," p. 50 (1902).—The upperside in both sexes, like the palest, or most yellow-fulvous, examples of *colorado*. Underside yellow or grey-yellow (*colorado* is described by Scudder as from olivaceous to griseous-green); the spots white as in *colorado*. I consider it a variety of *colorado* (Edwards).

δ. var. *oregonia*, Edw., "Can. Ent,," xv., p. 150 (1883); Dyar, "List North Amer. Lep.," p. 49 (1902).—Besides the three forms of *P. colorado** is another as distinct as any of them, which comes from California and Nevada. I have 2 ♂s and 2 ♀s taken by Baron in north California, and 3 ♀s by Morrison in Nevada. Same size and shape as *colorado*, bright yellow-fulvous on upperside, the subapical spots of primaries placed as in the allied forms, but not so distinct nor well-defined. On the underside the colour is greyish-yellow; the spots of both wings scarcely lighter than the ground (not white, therefore, or even light), the band on secondaries slight, and often macular; in one of the Nevada specimens it is altogether wanting, except for a dot near outer angle. This form cannot be ranked with any of Scudder's, and is apparently constant (Edwards).

ε. var. *nevada*, Scudd., "Mem. Bost. Soc. Nat. Hist.," ii., 347 (1874); Spey., "Can. Ent.," xv., p. 143 (1883); Edw., "Can. Ent.," xv., p. 147 (1883); Dyar, "List Nth. Amer. Lep.," p. 50 (1902).—Judging from the specimens which have fallen into my hands, this is the most abundant species in the west, and is one of the most widely spread, having been taken in Colorado, California, Nevada, and Oregon. Specimens from the latter region are a little paler upon the under surface than those from more southern localities, and the same is true of the upper surface of the ♀s. The species is of the size of *P. comma*, and the ♂s differ from those of *P. comma*, and of all the other species of the genus (excepting the larger *P. ottoe*), in the clearness of the upper surface of the wings; occasionally, the wings are somewhat suffused with dusky, but usually the hindwings have only a narrow edging of blackish, broadened naturally along the costal border, and the forewings, instead of having a distinctly limited bordering, as is common to a greater or less extent in most species, have the wing gradually more and more suffused with a warm but dusky tint towards the tip, as is not unfrequently the case in *P. comma*; sometimes the mesial belt of the under surface is visible above, but occasionally, at least, it is wholly absent. The ♀ scarcely differs upon the upper surface from the ♀s of *P. manitoba* and *P. comma*, except in almost uniformly having the small subapical spots, both those near the costal and those near the outer border, paler than the others, or nearly white, as occasionally happens in the ♀ of *P. comma*. Beneath, the mesial white band of the hindwings is more irregular and scattered than in *P. comma* or *P. manitoba*, in the ♂ it is usually broken up into four separate patches, connected

* What Edwards means by this we cannot comprehend, possibly *idaho*, *nevada* and *manitoba*, although he repeatedly asserts the distinctness of the two last-named.

by their angles only, into a continuous angular belt; three of these patches, of nearly equal size, but the middle one usually the largest, lie in a straight line parallel to the longer axis of the wing, situated one each in the subcostal and subcosto-median interspaces; the last patch, not much larger than the second, is composed of three confluent spots in the median and medio-submedian interspaces, as far from the outer border as the second patch, the medio-submedian spot further removed from the border than the rest; the ground colour of the wing is a greenish-griseous, and the spots are narrowly edged exteriorly and interiorly with blackish. The markings of the ♀s are similar, except that they are usually a little larger and more obviously continuous, often sending out on the exterior border little shoots of white along the nervures. Winnipeg specimens of *P. manitoba* seem to approach this species closely in the markings of the wings. In the genital armature the upper organ is bent at right angles in the middle and scarcely rounded, deeply sulcated posteriorly above along the middle; hook almost three-fourths the length of the centrum, straight, moderately stout at the base, as seen from above, where it tapers rapidly, afterwards slender and gently tapering; lateral arms slender, gently tapering, nearly straight, but little separated at the base from the hook, upturned at the tip to meet the hook, which they slightly exceed in length. Clasps rather small, twice as long as broad, not extending nearly so far back as the upper organ, narrowing pretty regularly from the base, the upper margin incurved and slightly deflexed, the posterior border rounded and protuberant; the preapical tooth is longer than the apical, very slender and curved, like the apical, a little forward; they are separated from each other by a deep, rather wide, rounded excision; the apical tooth is supported by a serratulate lamina, which is the continuation of its inner anterior edge, and which terminates by a conspicuous serratulate denticle opposite the posterior edge of the preapical tooth. It has been taken in Colorado by Mr. Mead, on the mountains about the South Park and in the Park itself. Mr. W. H. Edwards has also sent me specimens from Nevada, California and Oregon, the last collected by Dr. Gabb (Scudder).

ζ. var. *laurentina*, Lyman, "Can. Ent.," xxiv., pp. 57-59 (1892); Dyar, "List Nth. Amer. Lep.," p. 50 (1902).—Very uniform in colour; the outer third of the underside of the forewings and the whole of the underside of the hindwings with the exception of the inner margin and hind angle, of a dark brown colour, though occasionally with a slightly greenish tinge. Cacouna, Rivière du Loup, Metes, Gaspé (Lyman).

η. var. *assiniboia*, Lyman, "Can. Ent.," xxiv., pp. 57-59 (1892); Dyar, "List Nth. Amer. Lep.," p. 50 (1902).—Differs from *manitoba* of the Lower St. Lawrence (*i.e.*, var. *laurentina*) in that those parts of the underside which are brown in the latter are of a very pale greenish-yellow, or yellowish-green, in the Regina form, but it also differs somewhat above, in that the ♂s are usually of a yellower tone, while the brown of the ♀ is decidedly darker and the spots of the forewings decidedly lighter (some of them being almost white) than in the eastern specimens. Regina (Lyman).

θ. var. *manitoboides*, Fletch., "Rept. Ent. Soc. Ont.," pp. 19, 86 (1888); Dyar, "List. Nth. Amer. Lep.," p. 50 (1902).—This active skipper . . . . belongs to the *comma* group of the genus *Pamphila*, and bears a somewhat close resemblance to *P. manitoba*, for which reason we call it *manitoboides*. It occurs, however, six weeks sooner at Nepigon, than an insect I take to be true *manitoba*. As I do not wish to cause confusion by naming what may prove to be a described species, I refrain from further describing the perfect insect, but give below some notes on the egg and the larva after the third moult, and on the appearance of the young larva in the first two stages. Egg.—Five eggs were obtained upon the grass *Danthonia spicata*. These were laid upon the green leaves and were large and showy, of a dull dead white, and of the same shape as those of *P. hobomok*. Under the microscope the shell presents a surprising appearance, for it is covered all over with threads and much resembles a piece of ordinary printing-paper under a magnifying-glass. The shell of the empty egg is very thick, and it is with difficulty that the pentagonal and hexagonal cells on the surface can be made out. Eggs laid July 10th hatched upon 25th. There was no mottling with pink as in *P. cernes*, and the only indication that the eggs were good was the gradually darkening head of the young larva which showed through the thick shell. Larva.—The newly-hatched caterpillar is of a much yellower shade of cream-colour than either *P. cernes*, *mystic* or *hobomok*. The head, thoracic shield and first thoracic feet, black. The whole body covered with knobbed hairs. Unluckily at the time

the young caterpillars hatched . . . . my microscope was inaccessible, and the only observations I could make then were made with a Codington lens. The shape of the young larvæ was sack-shaped, somewhat like the grubs of the Scarabæids, but not having the anal segments curved under the body. From the very beginning, when the young larvæ were placed upon a tuft of growing grass, they worked their way down to the bases of the leaves and kept out of sight. About four days after they hatched I lost sight of them, and it was not until August 4th that I found them again. They had evidently moulted, for, instead of a yellowish-white, they had now assumed a delicate glaucous tint, *i.e.*, an opaque white, with a faint bluish-green shade on the surface. The head and spiracles, as well as the thoracic shield and first pair of thoracic feet, were black as at first, making a continuous collar from the tip of one foot to the other. Down the centre of the back there was a green line from the dorsal vessel, showing through the skin. At this time they were transferred to a smaller tuft of grass consisting of small roots of *Agrostis vulgaris* and *Carex varia*. They seemed to eat either of these indiscriminately, and eating their way down into the heart of a shoot, would nibble the edges of the leaves all round them. Leaving home to attend the meeting of the American Association for the Advancement of Science, no note was taken of the date of the next moult. Indeed, I supposed that these, like some others, had died during my absence. One morning, in the month of September, however, to my great pleasure, I found one of these larvæ snugly ensconced, head upwards, in a den it had eaten out of the centre of one of the shoots of sedge. When it emerged to feed I found it had quite changed its colour. In the beginning of October it came out of this den, and for some reason it did not return to it again, but climbed about on the grass and sedge, and before it had constructed other winter-quarters, the cold weather set in. In November it had spun together a few leaves of grass, but this seems to have been insufficient. Some warm weather in December caused a mould to spread all over the plant, and, having decided that the caterpillar was dead, I placed it in alcohol. The following is a description of this larva after what I consider was its third moult. Length, 7 lines. General colour, greenish-brown, with head, thoracic shield and thoracic feet black. Head round, larger than either of the first three segments, very coarsely punctured and thickly invested with short pointed bristles. About the mouth-parts a few long bristles, thoracic shield black on a pale collar, and having two longitudinal furrows, and bearing some truncate bristles just above the large spiracle on segment 2 (prothorax). The shield is divided by a transverse line which cuts off a small triangular piece, of which the apex points downwards just over the spiracle. This triangle bears one long setaceous bristle similar to those on *Chionobas jutta* and *C. macounii*, and also one concave disc of the same nature as those on *Cyclopides mandan*. The whole surface of the body is minutely shagreened, and has the raised portions darkened. Besides this, the whole of the body but the head is covered with small black tubercles, each of which bears a short white trumpet-shaped hair, which is apparently stellate, or bears a few short teeth, at the top. On the thoracic shield these are rather longer than on the rest of the body, but less clubbed. On the last segments there are a few long bristles, particularly upon the anal flap. Beneath the body are also a few pointed bristles upon the last two segments and on the prolegs and thoracic feet. Thoracic feet black and bristly. Spiracles black and distinctly protruding (in the dead specimen). Concave discs: This species also bears two series of the processes mentioned under *Cyclopides mandan*; in this instance, however, they are more like annuli, the edges of the discs being raised and black. They are arranged as follows: There are two series, all of which, except the pair on the base of the thoracic shield and a pair on the anal flap, are below the spiracles. On segment 2, above spiracle and on base of thoracic foot; on segments 3 and 4, on base of thoracic foot, large; on segment 5, just below second stigmatal fold, large; above it is what appears to be another disc, but which bears a truncate hair twice the ordinary length; on segment 6, on upper stigmatal fold, in the same place as the bristle on previous segment, and below lower stigmatal fold; on segments 7-10, on upper stigmatal fold and just above the foot of each proleg: on segment 11, one large disc below stigmatal fold, having just above it a similar one, from which comes a long pointed bristle. On one side of the body this tubercle bears two bristles. Those on the feet each have below them two similar bristle-bearing discs. Segment 12 has one large disc with two or three bristle-bearing tubercles round it. Segment 13 has a small one at the base of the second stigmatal fold in a line with the spiracles, and also another small pair above, one on each side of the anal flap (Fletcher).

ι. var *columbia*, Scudd., "Syst. Rev.," p. 56 (1872); Edw., "Can. Ent.," xv., p. 148 (1883); Dyar, "List Nth. Amer. Lep.," p. 49 (1902). *Sylvanoides*, Scudd., "Mem. Bost. Soc. Nat. Hist.," ii., pt. 3, pp. 344, 351, pl. x., figs. 20-21; pl. xi., figs. 15, 17 (1874); Speyer, "Can. Ent.," xv., p. 145 (1883).—Differs from *manitoba*, with which it agrees in size and general appearance, in having the sexual dash on the forewings of the ♂, slightly shorter and edged beneath with a brown border as broad as itself, and in having the band on the under surface of the hindwings formed of more closely connected spots. The apical superior tooth of the lateral clasps of the anal appendages is very large, while the subapical tooth is nearly aborted. Captured in California by H. Edwards (Scudder).

Under the name of *sylvanoides* (*Mem. Bost. Soc. Nat. Hist.*, ii., p. 352), Scudder says that this insect is most nearly allied to *manitoba*, smaller than *comma*, and differs from all the species of this genus in that the discal dash upon the upper surface of the forewings in the ♂ appears nearly twice as broad as usual, from the presence of a patch of dark brown scales along its inferior surface; the upper surface of the forewing of the female also differs, he says, from that of any other species in having a quadrate transparent spot in the lower median interspace just below the last divarication of that nervure, and a partially transparent triangular patch at the extreme base of the upper median interspace; these are not given with sufficient distinctness in the plate; besides the three little yellowish subapical patches lying one beneath the other next the costal margin, as mentioned by Boisduval, there are two similar but squarer patches in the interspaces beyond the cell and nearer the outer margin. The upper surface of the hindwing of the male does not differ from its usual appearance in *P. manitoba*; that of the female is mostly dusky, with a tawny patch near the base, and in the middle of the outer half of the wing a broad, tawny, transverse patch double the breadth of the belt of the under surface. Beneath, a silvery white (♂) or pale (♀) slender belt of small quadrate spots, similar to that of *P. comma*, bent at a little less than a right angle, the portion at right angles to the inner border straight and continuous, the inner portion sometimes broken, sometimes continuous and straight. Of the genital armature, the upper organ is strongly arched, deeply sulcate above posteriorly; hook about one-third the length of the centrum (but in the only male specimen at hand, broken, doubtless of the *comma* type); lateral arms cylindrical, very slightly tapering, not very widely separated at their base, beyond straight. Clasps about twice as long as broad, not extending so far backward as the upper organ, narrowing pretty regularly, the posterior border well rounded, scarcely extending beyond the apical tooth, which is pretty large, erect, triangular, pointed and separated, not widely, by a moderately deep, rounded excision, from the preapical tooth; this is but a slight, triangular, compressed denticle, removed from the upper edge of the clasp, the height of which it attains by a slight excision; the lamina supporting the inner anterior edge of the apical tooth is distinctly and sharply serrated, terminating some distance in advance of the preapical tooth by a serration twice as large as the others, and much larger than the preapical tooth itself. This species has only been taken, and rarely, in California (Scudder).

κ. var. *juba*, Scudd., "Syst. Rev.," p. 56 (1872); "Mem. Bost. Soc. Nat. Hist.," ii., p. 349, pl. x., figs. 19-20, pl. xi., figs. 5-6 (1874); Speyer, "Can. Ent.," xv., p. 142 (1883); Edw., "Can. Ent.," xv., p. 147 (1883); Dyar, "List Nth. Amer. Lep.," p. 50 (1902).—This species of *Pamphila* is larger than any other,

with the exception of *P. ottoe*, which scarcely exceeds it, but, on the upper surface, resembles closely the preceding (*colorado*), differing from it in having the mesial band of the underside of the hindwings more conspicuous upon the upper surface of the males than in *P. colorado*. The ♀s are peculiar for their pale appearance, due to three causes: a really paler tint to the tawny parts of the wing, in which respect they resemble the Oregon specimens of *P. nevada*; a narrow, dark, outer border to the wings; and the much broader mesial belt of the hindwings; more than in any other species, the interior edge of the outer margin of the forewings of the ♀ is very crenate, the brighter ground following the nervules nearly to the margin of the wing, while at the base of the lower median interspace, and in the interspace below it, are a couple of continuous, or nearly continuous, dark brown patches, resembling those which so often accompany the inferior edge of the discal patch of the ♂ in this group of *Urbicolae*. Beneath they are peculiar in having the mesial band of the hindwing broader than in any other species, and rather more uniform than usual, the spots of which it is composed being white, nearly square and equal, and forming a belt, bent in the middle almost exactly at a right angle, or in the ♀ at slightly less than a right angle; in the ♂ the belt is almost wholly continuous, although sometimes broken at the lower subcostal nervure, but in the ♀ it is usually broken both here and at the upper median nervule; the ground-colour in both sexes is a greenish-griseous. The genital organs show the upper organ as in *P. colorado*, but considerably stouter. Clasps not large, extending nearly as far as the upper organ, nearly, or quite, as long as broad, the upper border furnished with a slight swelling next the base, but otherwise tapering regularly, the posterior margin well rounded, extending considerably beyond the apical tooth, as in *P. comma*; this is slightly shorter than the pre-apical tooth, and separated very narrowly from it by a deep round excision, both the teeth are incurved, but nearly erect; the inner anterior edge of the apical tooth is sharply denticulated, but it hardly extends forward into a serrated lamina. This butterfly occurs in California and in the neighbourhood of Salt Lake City, Utah (Scudder).

Of this, Speyer writes (*Can. Ent.*, xv., p. 142): "*Juba** differs from *comma*, as also from its American congeners as follows: (1) *Juba* is larger than *comma*. (2) It has a somewhat different outline of wing, etc. (3) The ground-colour of the primaries bright orange, especially in ♀, the brown marginal band very dark, and, towards the lower end, much more sharply defined than in *comma*, etc. (4) The ♂ discal stigma is longer than in *comma*, proportionately narrow, its upper end pointed and distinctly bent, not so straight as in *comma* and the other American forms. (5) In the ♀, two dark brown spots, separated by the second nervule, stand out very prominently on the bright ground in the disc of the primaries, and between them and the dark margin is a broad space of clear orange; in *comma* ♀ the two spots are also present, but mostly united, and cohering with the dark spot below the apex of the wings, but the two spots are not so dark nor sharply defined and prominent as in *juba*, etc. (6) The underside of the secondaries is, in *juba*, as strongly sprinkled with fuscous as in *comma* var. *catena*, and has also equally large, bright, white-chequered spots, in one ♀ the arrangement of the spots corresponds with *catena*, in the other three (2 ♂s, 1 ♀) the row is more irregular and broken, while the spot between the fourth and sixth nervules is quite separated from the sixth cell, and is placed nearer to the margin; in two examples (♂ and ♀) the spots are united. Evidence is thus afforded that the form and order of these spots, even in specimens undoubtedly closely related, are subjected to great variation. *Juba* is, at any rate, a very well-marked local form of *comma*." Four examples (without locality) in the Hewitson collection in the British Museum, appear to be rightly

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* The two pairs Speyer possessed are noted as "from Utah (♂ and ♀) and California (♂ and ♀), all unfortunately more or less worn and mutilated."

named. We have no doubt that they represent a very bright form of *U. comma*.

λ. var. *viridis*, Edw., "Can. Ent.," xv., p. 147 (1883); Dyar, "List North Amer. Lep.," p. 50 (1902).—I am satisfied that *juba* should rank as a species. . . . I have a beautiful variety of *juba*, a ♂, sent me by Snow, taken at Los Vegas, N.M., in 1882. The upperside is darker—more fuscous and less fulvous—than any other example I have seen; the secondaries beneath and the apical area of primaries are densely dusted with golden-green; the spots white and somewhat smaller than in the type. I call this var. *viridis* (Edwards).

Egglaying.—The eggs are laid singly on grass, being so observed on August 1st and 3rd, 1896. The ♀ feels with her ovipositor several blades of grass before selecting one on which to deposit an egg, which appears always to be laid singly, although a second may be deposited within half-an-inch of the first. The ♀s will also lay in confinement if placed in a suitable glass jar with a grass-plant, etc.; in this condition they will also lay eggs on leaves and stipules of clover (Hamm). An ovipositing ♀, after walking for a little time over and among the culms of a tuft of *Aira caespitosa*, on which she was observed to settle, August 17th, 1900, curved her abdomen down and deposited a single egg on one of the fine hair-like blades, or rather spines, and close by, within an inch, I found another egg, similarly laid, which, from its darker colour, appeared to have been laid about three or four days previously. Confined over a plant of grass, the ♀s, on August 20th, laid a large number of eggs upon the grass stems and blades (Frohawk). Females were observed buzzing among the herbage, on Ditchling Beacon, early in September, 1902, and careful searching resulted in the finding of several ova (Dollman). The eggs live through the winter, the young larvæ not leaving them until the following March, some laid on August 24th, 1867, hatched on March 27th, 1868 (Hellins); the embryo being fully-formed in early October and lying coiled up in the eggshell until the following spring (Bacot).

Ovum.—Attached by base which is somewhat flattened. Base almost 1mm. in diameter, height about ·7mm. In shape a flattened dome, with the faintest bluish tinge on the pearly-white colour when first laid, quickly changing, however, to shiny chalky-white; a conspicuous slaty-coloured, circular, basin-like, micropylar depression. The shell, under moderate power, minutely pitted. The micropylar depression edged with similar pitted cells; at bottom of depression the micropyle forms a tiny raised conical point. There is no trace whatever of longitudinal or transverse ribbing noticeable. An ochreous tint on the sides of the eggs suggests that the embryo is partly formed (September 16th, 1896), although the eggs do not hatch until spring (Tutt). The egg is hardly more than a hemisphere, the base quite flattened, the apical area depressed, the micropyle forming a raised point in the centre of the depression, the colour is, when newly exposed, pearly-white, but it changes almost directly to a shining chalky-white, the apical depression alone retaining the pale coloration. The whole of the surface of the egg is minutely pitted, and, under a lens, has the look and apparent texture of the shell of a hen's egg. There is no trace whatever of longitudinal or transverse ribbing, and the egg is as dissimilar as possible from that of the well-ribbed egg of *Hesperia alveus*, with which it was compared. [Tutt, described August 18th, 1903; Eggs dissected from a ♀ captured at Chamonix same day.] Base 1mm.; top rather flattened ·4mm.; height nearly ·8mm.; slightly roughened like

the shell of a hen's egg. The dark micropylar spot composed of minute black scratches or irregular lines (Buckler). Nearly 1mm. in diameter at the base; in shape exactly resembling a pudding-basin, having a sunken crown, rounded sides, and a well-developed basal rim; the base is quite flat; the surface is finely granulated, forming reticulations near the base which run into ridges to the rim. When first laid the colour is pearl-white with the slightest yellowish-green tinge which very gradually turns deeper in colour, assuming a pale straw-yellow on the 6th day, and, when a fortnight old, is of a clear apricot-yellow, which colour it remains until the middle of January, when a slight change begins to take place by the colouring gradually fading until it finally turns to an opaque-white with the faintest yellowish hue at the base, and rather leaden in certain lights on the crown. It remains unchanged during February and March; at the end of the latter month, or the first few days of April, it hatches. After hatching, the shell is dull opaque-white (Frohawk). [We have seen no egg of this species with a basal rim as here described. Probably this was a case like those (*e.g.*, *Colias edusa*) described *Nat. Hist. Brit. Lep.*, vol. i., p. 9.]

Habits of larva.—The young larvæ leave the eggs in late March (March 27th) and early April (1st-7th), each one eating a circular hole in the crown of the egg through which it emerges. It is then about 2mm. long, and, if disturbed, immediately rolls itself up, and remains motionless for several minutes. Directly after leaving the egg it spins the fine grass together into a somewhat dense cluster an inch or two above the ground, living in this shelter and feeding upon the grass surrounding it, remaining almost always completely hidden. Sometimes as many as three or four live together. It appears to be chiefly nocturnal, resting quietly during the day, and is exceedingly difficult to see, so well is it hidden. In some, reared in confinement, the first moult took place May 1st and 2nd, second moult May 28th, third moult about June 14th, fourth (and last) moult about July 8th or 9th. All this time they live entirely concealed in the tubes of grass spun closely together. They crawl rapidly either forwards or backwards, similarly to other case-dwellers, and feed on any species of grass that happens to be interwoven with the hair-grass selected for them. If disturbed when crawling, the larva frequently wriggles backwards very rapidly, similarly to the habit of wriggling possessed by many micro larvæ (Frohawk). The habits of the larva in nature were observed by Staudinger, on a turf-covered sandbank in the Althenthal, in Finmark, in June, 1860. On the 8th, several larvæ were found forming, close to the ground between the grass, what may be described as slightly spun passages, ending in a tube formed of gnawed grass-culms, joined together, which were either buried in the sand or fastened under some sheltering object. The first larva was observed as it put its head out of its tube to feed on the surrounding blades of a thick tuft of grass, eating with

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* Gillmer writes that eggs received by him "from Schwerin-in-Mecklenburg, on August 4th, 1900, were hemispherical in shape, somewhat sunk in on the top; of a reddish-yellow tint which became after a few days (August 18th) paler yellow, even almost whitish; although some of the eggs even then remained reddish-yellow. The walls of the egg are netted, the network consists of irregular polygonal cells, which are especially distinct towards the micropylar depression of the summit. The base is flat and without any special characteristic. Diameter of base *circ.* 0·8mm., height *circ.* 0·65mm.-0·7mm."

great speed, and quickly retreating when an attempt was made to capture it; several others were found later, some under a piece of very dry cow-dung. . . . Freyer's drawing, he says, seems to be an accurate one of this species, and his failure to rear it was probably due to his attempting to feed it on *Coronilla varia* instead of grass, whilst Hubner's larva described under this name is probably erroneously referred to this species. The larva is only apparently lazy, for, before its final metamorphosis, or earlier if taken out of its tube, as well as in nature, when feeding, its movements are remarkably rapid. The larva leaves the feeding-tubes when fullgrown and makes a special puparium in which to undergo its final metamorphosis (Staudinger). [Rühl's remark, based on that of earlier authors, that the larva lives in a tent formed of the leaves of *Coronilla varia*, is possibly altogether inaccurate.] Wocke found the larvæ commonly in Silesia in tubiform dwellings in the tufts of *Festuca ovina*. See also *anteà*, p. 171.

Ontogeny of larva.—*First instar* (April 1st, 1901): 2mm. in length. The head proportionately large, the body swollen at the middle, attenuated at both ends, but mostly so on the prothorax, which is furnished with a dark brown shining collar. It is wrinkled transversely and lobed laterally. The entire body is of a rich deep straw-yellow, which becomes paler after feeding; on each side are four longitudinal rows of very minute knobbed points all of about equal size; the first and second rows are dorsal and subdorsal, the third and fourth are supraspiracular and subspiracular; except those forming the latter row, all the points are directed forwards, those on the anal segment are longer and only slightly clubbed; along the lateral region, including the claspers, are a number of minute spines pointing downwards; all the points and spines are white and glassy, with dark bases; the entire surface is granular; the head shining black, granulated, bearing a number of tiny whitish spines. The mouthparts are brown; the legs and claspers the same colour as the body. Just before the first moult it measures 4mm., and the colour is the same as when first hatched. *Second instar* (May 2nd): Soon after the first moult the colour along the dorsal surface has a decidedly greenish tinge; the rest of the body pale straw-yellow. It is more thickly sprinkled with minute white glassy angulated knobbed points with black bases, and on the dorsal surface of each segment are two shining black spiracular-like rings, and another just above the true spiracle, also on the meso- and metathorax are two larger ones precisely like spiracles; all these, as well as the spiracles, are black. The head is similar to that of previous stage. The prothorax, which is freely retractile, has the anterior half, which is the elastic portion, of a lilac-flesh colour, the posterior half having a shining black band encircling the upper half. Shortly before the second moult it measures 7mm. *Third instar* (May 28th): The anterior segments, especially the prothorax, much smaller than the rest of the body, the latter being considerably swollen about the middle; the anal segment has the dorsal surface speckled with brown. Shortly before the third moult (when about seventy days old) the larva measures, when resting, about 9·5mm. The general colour is pale greyish-green, but some are of a decidedly ochreous hue; in all other respects they are precisely similar to previous stage. *Fourth instar* (June 14th): The whole of the colouring of the body is of a dull olive-green, slightly paler on the ventral surface, including the claspers; the legs are black and shining.

The head now exhibits two ochreous vertical parallel lines down the crown, and an ochreous ∧-marking above the mouth; otherwise the form and structure of the larva is similar to the earlier stages. *Fifth instar* (July 9th): Fullgrown, measuring 28mm. in extreme length while crawling. The head is large and similar to previous stage in colour. The prothorax very small, elastic, and retaining the black collar of former stages; the following segments gradually increase in size to the 3rd abdominal, and taper from the 6th to anus. The entire surface is densely sprinkled with minute shining black warts, each emitting a tiny amber-coloured spine or seta with a cleft knobbed apex; those on the ventral surface are simple spines and rather longer. The skin is also covered with fine regular granulations which are dusky in colour, and exceedingly minute. Besides these there are, sprinkled over the whole surface, very small spiracle-like processes, the largest being situated on the claspers (which have a shining whitish film-like surface stretched over the centre), and one on each segment below the true spiracle, which is conspicuous, black and shining. The 7th and 8th abdominal segments have the anterior half of the ventral surface covered with a rough white granular waxy substance* (Frohawk).

Larva.—The prothorax has a transverse black plate, about 4mm. across, and about 0·4mm. wide; from the appearance of the fracture, in casting the skin for pupation, there is no very definite dorsal suture; it carries several hairs, as well as certain ocellations that may be lenticles or merely bases of hairs that have been lost; it has a paler line with darker margins, that seems to be a groove or channel passing across about one-third from the posterior margin; there is a paler band near each extremity, marking off a terminal area, very similar to what occurs in many Psychids; the whole surface is finely spiculated precisely like the rest of the cutaneous surface. Just beyond the end of the plate is the dark spiracle, more prominent, but not larger, than that of the 8th abdominal segment, the other abdominal spiracles are smaller and much less prominent, but all appear to have much the same structure. This prothoracic spiracle is about 0·25mm. long, 0·15mm. across, and about 0·06mm. high; it has a very narrow outer oval ring, then the chitin of the spiracle proper rises, maintaining the same diameter to the stated height of about 0·06mm., and then curves inwards for about 0·03mm., leaving the lumen of the spiracle; it, however, occupies a good part of this space by chitinous processes, much like the pectinations of an antenna, and similarly clothed with fine hairs; these proceed from the whole margin, but chiefly from the sides, most of the central ones being parallel, they just do not meet in the centre; on the thoracic spiracles, they are about twenty in number on each side. The abdominal spiracles are of precisely the same structure, but are only 0·15mm. long, are nearly flat and have about fifteen gills on either side. Halfway between the spiracle and the first legs are a pair of lenticles side by side; these are dark rings about 0·09mm. in diameter, with a pale structureless diaphragm (on a higher magnification the membrane is seen to be very finely granulated, granulations less than 0·001mm.). Some of the

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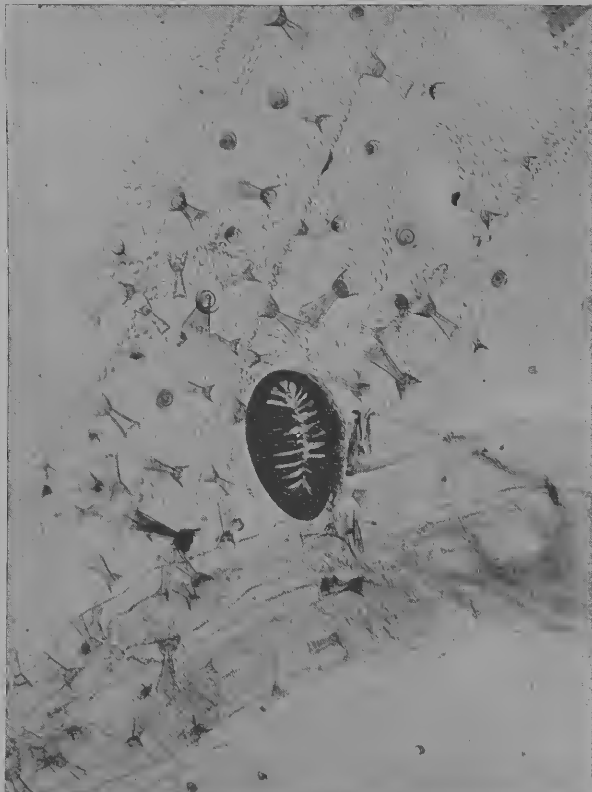
* Staudinger notes (*Stett. Ent. Zeit.*, 1861, p. 357), in his description of the full-grown larva taken in nature: "The most extraordinary feature of the larva is a snow-white exudation, which extends almost entirely over the 10th and 11th segments ventrally, rather thick, scaly in form and sticky. Under considerable heat it melts like wax and loses the white colour completely."

other lenticles are rather larger, some are rather oval and a good many are a little irregular in outline, and more have a peculiar variation. In all, the chitinous ring has a darker outer margin and a pale inner half, not fading into, but sharply demarcated from, the drum-like membrane. In these specially varied specimens, this inner pale portion of the ring sends into the middle of the ring finger-like processes, sometimes only amounting to a slight angulation of the margin, in others reaching to the middle of the ring; there may be one or more of these, one is observed to have one long one of these and six others of various lengths, besides two or three angulations. On the metathorax are three lenticles on each side, at about the situation of tubercles i, iii and vi, really about an equidistant distribution; on the mesothorax, however, the middle one of these (iii ?) is absent and its place occupied by a very long slender hair, a hair nearly 0·5mm. long. On the abdominal segments is one dorsal lenticle (i ?) and one below spiracle (v ?) and a nearly ventral one (vii ?); the lowest of these (vii ?) is absent on the segments with prolegs; the 8th and 9th abdominals are not clear in the preparation, but seem to have a slightly different arrangement. The anal plate carries on each side three hairs marginally and one (at least) higher up. These are strong thick bristles 0·4mm. to 0·5mm. long, and not such slender filaments as that on mesothorax. Beneath the anal plate is an anal comb about 0·36mm. long and 0·30mm. wide, divided into fifteen tines, which are all of about equal length, and are distinguishable from each other right to the base, but united side by side except just at their tips. The anal claspers are about 1·4mm. across, form nearly four-fifths of a circle, and possess about 120 hooks, apparently all in one row, but on one side (inner) of three sizes, looking much as if in three rows, and on the other side in two sizes similarly disposed. The ventral prolegs are practically complete circles, of about seventy hooks, also in three sizes, but less regularly placed as one of each together than in the claspers, so that they look for the most part as if of two sizes. They appear to have very little, if any, pedicel, though on their outer aspects are six or eight genuine bristles, about 0·1mm. long. The only other positions in which genuine bristles occur are (1) one or two near the subspiracular lenticle and (2) one or two (together) halfway between this and the prolegs. The skin is covered with fine and very sharp skin-points, apparently hard bits of chitin, seen in plan more or less irregularly quadrangular, but in profile triangular, the free apex being a very sharp right angle. They are about 0·005mm. from point to point. The most notable feature of the larva is its complete covering of secondary hairs. These are minute and very numerous, perhaps 0·03mm. to 0·06mm. long, and about 100 to 1 sq.mm. of surface. They vary a good deal in detail of structure, but may be classed as trumpet-hairs; they each have a raised thimble-like, or bell-shaped, base, to which is centrally articulated the hair, which is inversely conical, expanding (not in a curve but) in straight lines to its apex, the apex being two to three times as wide as the base. They appear to be cups, that is, the centre looks hollow and open at top, the margin terminates in a row of very sharp, saw-like teeth, sometimes directly, at others after a slight gathering in of the margin. The head is rounded (about 3·5mm. across ?, it is split up and the measure is doubtful), black, with a paler line down to clypeus, due to thinner chitin. The clypeus has similarly two lateral and two median paler lines, and carries a few bristles similar to those of proleg



*Phot. F. N. Clark.*

Spiracle and hairs of Larva of Urbicola comma (last stadium × 100).

*Phot. F. N. Clark.*

Larval skin of Urbicola comma, showing spiracle, lenticle, hairs and skin-points (last stadium × 100).

*Natural History of British Butterflies*, March, 1906.

bases. The cranium (?) is quite without hairs of this sort. Its sculpture is made up of circular dark marks (pits) with raised dark margins, the centre paler. These marks are from 0·04mm. to 0·08mm. in diameter and vary somewhat from strict circles, the areas between them are invaded a little by their outward slopes, but may be described as an intermediate plain, with from half to twice the diameter separating the circles. (These circles are the simplest form of head sculpture in similar larvæ, which becomes more complicated as they get more crowded together and form waved and other raised ridges.) These rings are not hairs, the true hairs are extremely minute, and occur in the smooth plain between the rings, their numbers are almost identical. The eye-spots are the usual five in a curve and one central one. The antenna, rising from a chitinous ring at base, has two joints, the first about 0·15mm., and the second 0·2mm., long, the latter carries a long hair (nearly 1·0mm.), and also a minute joint, which again has two very minute papillæ, one with a minute hair. The jaws are large, somewhat cubical, boxes; the cutting margin is a smooth curve, over 1·00mm. long, quite without teeth. There are more complicated and jointed maxillary palpi, but the details of these and the labium are not made out; the labrum is about 0·7mm. across, and has a central notch with the usual rounded lappets on either side. The true legs are black, with a rather short straight claw; the basal joints have many short strong bristles, as has also the basal area, which has a transverse dark plate strongest for the first, weakest for the third, pair. [Described from a cast larval skin; from a larva which was found at Albarracin in August, 1901. The larval skin was covered with the material from the larval pockets under the 7th and 8th abdominal segments; so great was the quantity that I thought I must have left the box somewhere, where the larval-skin and pupa-case had been destroyed by mould. Closer examination, however, showed at once that the material with which they were covered was the white, glistening, fibrous, asbestos-like powder excreted from the larva, and the way in which the larval skin had the larger share, doubtless made more obvious by its being shrivelled up, showed that the distribution of the powder was made whilst the larva was still actively spinning. The material instantly dissolved off the larval-skin when benzole was applied to it, as a necessary preliminary to endeavouring to soak the skin in order to make some examination of it. I was not very successful in unravelling the shrunken skin, but did so sufficiently to be able to note the few structural points detailed above (Chapman).] 30mm. in length when fullgrown. Head heart-shaped, glossy-black, with a pale brown patch on each hemisphere; below is a similarly coloured upturned-∧ which limits the triangular forehead; in proportion to the larva, the head is rather large and divided by a deep indentation extending from the small prothorax, as in all other Urbicolid larvæ. The prothorax carries dorsally, on the hinder half, a narrow, horny, black ring, which extends to the large black prothoracic spiracles. The colour of the body is a dirty greenish-grey, or black-grey, with a tinge of green. The true legs and spiracles are glossy black (Staudinger). See also *anteà*, p. 171.

Foodplants.—*Aira caespitosa* (Frohawk), *Festuca ovina* (Wocke), *Poa*, *Triticum*, *Holcus* (Rühl). [Also recorded as feeding on *Coronilla varia* (Schiffermüller, etc.), *Ornithopus perpusillus*, *Lotus corniculatus*, etc. (Merrin).]

Puparium.—In nature, the puparia are spun on the ground, and

consist of a silken web in which are spun together gnawed pieces of grass, sand, etc. (Staudinger). The puparium consists of a strong coarse network cocoon, formed among the grass close to the ground; the loose gnawed pieces of grass, woven with the fine stems and blades; in this the larva pupates in July, the cremastral hooks being very securely anchored to a pad of silk spun for the purpose at one end of the cocoon, whilst the long hooked hairs of the head are also fastened into the cocoon so that the pupa is securely anchored fore and aft (Frohawk); the larva covers the inside of the puparium with the white asbestos-like material from the larval pockets under the 7th and 8th abdominal segments, and the pupa is covered with this material, undoubtedly derived from the walls of the cocoon when moving about (Chapman); the pupa moves very quickly when touched, and, occasionally, rises for some considerable time with the anterior part standing up vertically. The pupal period lasts about four weeks (Staudinger). The very slight silken puparia were found on the Reading downs, spun up among the short herbage near, but not actually upon, the ground (Hamm); these were noted by Barrett as forming a rather strong but rough cocoon of white silk, with abundant open-work, the surface garnished with short pieces of dry grass-blades and bits of moss, between which the pupa is clearly visible; the anal segment of the latter has a large, triangular, brown, horny projection covered with bristles, terminated by a small, straight, blackish spike surrounded by slender, but very strong, hooked bristles, by which the pupa holds its silken envelope with great tenacity.

Pupa (described from empty pupal skin).—*General description:* Light greyish-brown in tint, with darker (blackish) and lighter (greyish) marblings over the head and thorax; stout in build, about 20mm. long and nearly 5mm. wide (mesothorax to 4th abdominal). Front end rounded, no nose-horn, body tapers to anus almost like a Noctuid pupa, *i.e.*, at first slowly, then more rapidly; wings extend only to just beyond middle of the 4th abdominal segment; the third pair of tarsi project from beneath them to end of extended segment, but free from it, supporting maxillæ, which proceed as a free appendage to end of the 6th abdominal segment when segments are contracted (to end of the 5th only when extended); hairs present over surface (except appendages), in four or five transverse rows on abdominal segments; the hairs bristle-like, pale, about 0·15mm. long. *Detailed description:* ♀. [In order to see the pupa clearly it was necessary to dissolve off the white asbestos-like powder with benzole.] The first thing that strikes one is that the hairs are of a totally different character and arrangement from those of the larva. The pupa is 19mm. long (if the 5th and 6th abdominals were not somewhat telescoped, the length would probably be 20mm.). Neither nosehorn nor any frontal projection. It is comparatively stout, and though, being dehisced, and, therefore, distorted in various ways, so that some measurements are not possible, it appears to be 4·7mm. across the 4th abdominal segment, and apparently rather stouter in front; from the 4th abdominal it tapers very slightly at first, then more rapidly to the somewhat sharp cremastral spine. In front the pupa is rounded. The convexity of the glazed eyes is directed rather frontally than ventrally; the head- and eye-covers remain in one piece; the antennæ, legs and maxillæ separate from the head-piece. The dorsal head-piece is not discovered with certainty, it is either wanting or lost in this specimen, at least,

this is one's first and obvious conclusion, and it may be correct, but, on carefully examining the prothoracic piece, a strip along its anterior margin is marked off from the rest as by an obsolete suture; such a suture is unusual unless the part marked off be really the dorsal head-piece. There is also attached to one antenna a small portion that may be one-half the dorsal head-piece, or it may be a piece irregularly fractured from the head-piece, but, looking at the condition of the specimen, this is unlikely, especially as a similar amount is missing from the other side, it is coloured like the head, it is about 1mm. long, and 0·2mm. wide at the outer end, narrowing to a point at dorsal line. The head has very numerous fine hairs, except on the glazed eye, which is broad, glazed in the front and faceted below; the vertex is brown or blackish, with a large pale circle on each side; the face pale, the scape of antenna dark with a pale spot; labrum triangular; on each side and below it, a large rounded lappet (? mandible) with concentric ridges on its surface; these do not meet, but leave a narrow angular interval in which the labium appears; below these are the very wide maxillary bases, which immediately narrow and occupy middle line to their free extremities. The first pair of legs extend half-way down wings, very broad at tibial end; the second legs, of more uniform width, proceed from eye (shutting off first pair from antenna), to within 2·0mm. of end of wings, each with a black dot on tip; the antennæ with a marked and pointed club to somewhat further than front legs. The prothorax with three rows of hairs, and dark coloration except round hair-bases. The hairs on the head and thorax have their tips slightly bent, but are otherwise quite like those on the rest of the pupa. The spiracle-cover of the mesothorax (although the spiracle belongs to the prothorax) is a large bun-like projection, 0·5mm. × 0·25mm., and covered with minute hairs closely set, like a dense velvet pile. The mesothorax is long, and arches a long way back in mediodorsal line; the narrow metathorax is wide laterally and reaches forwards into the space between mid-mesothorax and wings. The mesothorax is marbled brown (? black) and terra-cotta, with many hairs whose arrangement is not definitely in lines. The dorsal slit of dehiscence does not quite reach the posterior border of the mesothorax. The metathorax, narrow in the middle (0·6mm.), is wider laterally (1·5mm.), and extends down into the hindwings without a suture, but with a slightly impressed line of division; the hindwings are narrow slips touching, but deflected by, the spiracles of the 2nd and 3rd abdominal segments, and ending before the posterior border of the 3rd abdominal is reached; they are slightly wrinkled but, like all the appendages, without hairs; the segment itself has a good many of the short pale hairs like those of the other segments (0·1mm. to 0·15mm. long); they have small raised bases, sometimes colourless, sometimes dark, there are perhaps 30 to 36 on each side. Continuing the dorsal view, the 1st abdominal segment is about 0·6mm. wide, and is faintly divided into an anterior portion, comparatively smooth, and a posterior with three transverse wrinkled ridges; these equally carry a few scattered hairs. The 2nd abdominal segment (1·3mm. broad) is not very definitely subdivided, and has twenty or more irregular transverse ridges; the very numerous hairs also have a transverse arrangement, one row near the hind-margin is fairly straight and continuous, but the next rows are rather scraps and portions of transverse rows that only persist

for a few hairs. The 3rd abdominal (1·3mm. broad) is more like the 1st, with a flatter anterior half, and the posterior presenting three ridges, the hairs are more numerous on the posterior half. The 4th abdominal is (extended) about 2mm. long, and has about four equal portions, *viz.*, two anterior fairly flat, then an intersegmental subsegment, with the fine sculpture of intersegmental membrane, but possessing hairs, etc., and then the true intersegmental membrane. The hairs are numerous, and, whilst giving the impression of transverse alignment, do not, in fact, anywhere afford very definite lines. The 5th abdominal segment is much like the 4th, 2mm. wide (extended); there are many hairs, of which two rows on the intersegmental subsegment and the row in front of this are fairly in alignment. The 6th abdominal is slightly narrower, but otherwise much the same. The 7th abdominal is about 1·3mm. wide, the intersegmental subsegment narrow, but what is most remarkable is that (in this dehisced pupa, a ♀) it easily extends from the 8th and displays a narrow border of real intersegmental membrane. The 8th abdominal is about 1mm., fairly uniform in surface, but with the posterior intersegmental subsegment distinguishable; the hairs are here rather longer than in front and more slender, 0·2mm.-0·24mm. long, but always ordinary hairs, nowhere any trace of the vase (or trumpet) hairs of the larva. The 9th abdominal segment is a dark, wrinkled, narrow portion, not easily distinguished from the 10th, which is represented by the cremastral spine, a conical piece 1·5mm. broad at base, nearly 2mm. long, dark brown in tint, longitudinally fluted or ridged, but so that there is, on either side of the dorsum, a larger and higher ridge underlying the others. It carries a good many hairs, roughly and inaccurately (in dorsal view), say four rows of four each. The terminal bundle of hooks (cremaster proper) is a little obscured by silk, the hooks are closely packed together about 0·2mm. or 0·25mm. long, slightly curved, and ending, each, in a recurved portion, nearly a complete circle, but so closely curved that there is no central opening. The sculpture of the 1st abdominal segment was described as in transverse ridges, but this obtains less and less on each following segment. The front margin (one-fifth of segment) of the 3rd abdominal segment has a series of little pits, not spherical but rather cylindrical hollows, with a plane surface between them; this obtains on the first element of the 4th abdominal segment and largely on the 2nd. On the 6th and 7th abdominals there is still a little tendency at the posterior margin of the segment for the plane surface to run into ridge-like form between the pits. With this in mind, it is easy to persuade oneself that the ridges on the 1st segment are really a special modification of the pitted surface. As a matter of colour, the first few segments have, trapezoidally placed, small, brown marks, that look slightly hollow, but probably due to the false perspective caused by their coloration, and being free from hairs; there are one or two similar marks more laterally placed. On the 2nd and 3rd abdominal segments are certain marks, probably to be classed as lenticles, and traces of them exist on other segments; they are a little further out than the presumed position of tubercle ii, one on the front and one on the back portion of the segment; the posterior is the most typical, and is a raised brown mark with raised dark sharp margin, narrow from front to back, longer in line across the segment. Taking a lateral view, the spiracles are not dissimilar to the mark last

described, but are larger (about 1·6mm. long, 0·04mm. wide) and dark brown in colour. The intersegmental subsegment is very marked on the 7th and 8th abdominal segments. Hairs are numerous. The sculpture is almost entirely pitting. Small lenticles (like spiracles, but half the length of the actual ones) exist on the 5th, 6th and 7th abdominals, close to posterior margin of segment, at about horizon of iii. The ventral aspect shows the dehiscence separating antennæ from wings and legs for about two-thirds of their length; the appendages are all finely wrinkled transversely; the free portion of proboscis deeply ringed so as to look like a rat-tailed file or a screw with fine thread; the ridges do not anastomose, but are complete circles, or would be if each half were not in contact with the other; in front of the 4th abdominal segment the wing-margin does not reach beyond the middle of the 2nd subsegment, but the extreme apex of the wing is produced, not as a gradual spreading of the hind-margin but, as a separate rounded lappet, right into the 3rd subsegment (the intersegmental one): from beneath these, about 1·2mm. of the 3rd tarsi appear, the proboscis reaching nearly 2mm. more. The lappet seems to be formed by its angle with the hind-margin being held back by the leg scar, a small elevation with several small circles (lenticles); a similar scar, with six lenticles, is on the 5th abdominal segment; on the 6th, it is not so fully developed on one side, but even more pronounced on the other. No other lenticles occur ventrally. The sculpture is chiefly in pits. No demarcation is visible between the 8th, 9th and 10th abdominal segments. On the middle line, immediately behind the 7th abdominal, is a longitudinal impressed line, rather faintly marked, 0·15mm. long, then, after an interval (about 0·15mm.), a longer, well-marked, depressed line, darkly coloured (about 0·4mm.); then, after about 0·4mm., the surface bends dorsally, and has a deep, well-marked anal scar, then (from the dorsal half of the segment) arises the cremastral spine, of much the same fluted and ridged aspect on this side as dorsally. Recurring to the wings, they have round their hind-margins, a wide strip (0·6mm.), marked off by "Poulton's line," which passes some distance up the costa (2mm.), and along the inner margin is still evident till opposite the 2nd abdominal. A point that is noteworthy is that the anal angle of the wing is on the abdominal incision 2-3, and so the slip of hindwing, passing, before disappearing beneath forewing, to beyond middle of 3rd, curls round the anal angle of forewing. This is the usual position of anal angle in Rhopalocerous pupæ. In obtect Heterocera it is usually opposite abdominal incision 3-4. The veins are distinct as paler (raised ?) lines, but veins beyond vii or viii are lost in the costa [Described from pupa-case, the larva of which was picked up at Albarracin, and from which the butterfly (a ♀) emerged some time afterwards.] (Chapman). The slender pupa is about 17mm. long; the wings show a blue bloom, whilst the other parts of the body, the head in particular, are covered with a mildewy-looking exudation. The ♂ pupa exhibits, in the middle of the wing, a marked longitudinal elevation, in which is formed the black androconial streak of the fore-wing (Staudinger). About 19mm. long. The head rounded; the thorax slightly swollen; the abdomen cylindrical and tapering, terminating in a long anal point furnished at the extremity with an ample bunch of cremastral hooks. The head, thorax and abdomen are clothed in short, stiff spines, below the spiracles they occur in dense

tufts. Those on the head are remarkably formed, all the longer ones terminating in a hook. These hooks (as well as those of the cremaster) are also fastened into the cocoon, so that the pupa is securely anchored fore and aft. At the base of the wing is a peculiar raised disc. The whole surface of the wings, antennæ and legs are covered with a lilac-grey bloom, which is very easily detached; it also covers the cocoon like whitish powder, and small flakes are scattered over the pupa, apparently of the same substance as that on the larva. The head and thorax are pale olive, mottled with blackish; the abdomen olive, spotted with dark olive, and inclining to yellow on the ventral surface; below each spiracle is a short longitudinal mark; the spiracles are amber-brown. [The foregoing description is of a ♀ pupa. That of the ♂ differs by having a well-defined, elongated dusky ridge covering the androconial mark on the primary wing] (Frohawk). Barrett also describes the pupa from an empty skin (*Ent. Mo. Mag.*, xxxii., p. 227).

Time of appearance.—The species is absolutely single-brooded, and rarely occurs in Britain until towards the end of July, continuing on the wing throughout August, and often well into September. These seem to be the usual months of its occurrence in central Europe—July 20th to end of August, at Autun (Constant), also in most parts of Germany, although earlier or later specimens occasionally occur, *e.g.*, May 29th and 30th, 1882, and June 16th, 1886, at Cranz, where July and August are the usual months for its appearance (Speiser). South of the Alps at low elevations, appearances in June and early July, are pretty general. Lambillion gives August and September for Belgium, and we note June to August is given for Göttingen (Jordan), Elberfeld (Weymer), Zeits-on-Elster (Wilde), Halle (Stange), Upper Lusatia (Möschler), etc.; in the Munich district from the end of June to September (Kranz), whilst Zimmermann tries to make it double-brooded, in the Hamburg district, May and July-August. Fritsch, however, is most active in this respect, and gives dates at Prague from June 15th to September 16th; at Brünn, May 5th-30th and July 23rd-November 2nd; at Salzburg, May 27th-June 13th, and August 28th-September 11th, etc. Meyer-Dür says (*Schmett. der Schweiz*, pp. 216-7) that the species is probably double-brooded in the lowlands, *e.g.*, at Burgdorf, where it appears about June 17th, and continues to the beginning of September, a break apparently occurring from mid-July to August 24th, whilst, on the heights of the Jura and the Alps, there is only one brood, *e.g.*, August 6th-10th, on the top of the Grimsel, on the Meyenwand, in the Valais above Varén, Leuk and on the Gemmi, and on August 14th in the Jura. We do not, however, believe even in the partial double-broodedness of this species, and Fritsch's conclusion, based on records spread over a long series of early and late seasons, is incomplete. The records probably all relate to a single brood, appearing early one year and late another. The following dates may prove interesting:—Continental records: In June, at the top of the Lokman (Fountaine); June 27th, 1867, at Gyrenbad on the Bachtel (Dietrich); September 1st-5th, 1882, at Pierrefitte Nestalas in the western Pyrenees (Jones); September 8th, 1890, at Spezia (de la Garde); July 28th-August 8th, 1894, at Courmayeur (Tutt); July 26th-30th, 1895, at Mendel Pass (Tutt); July 30th-August 5th, 1896, at Le Lautaret; August 5th-12th, 1896, at La Grave; August 12th-19th, 1896, at Bourg d'Oisans (Tutt); August

12th-25th, 1896, at Evolène (Rowland-Brown); rare and apparently over, August 10th-19th, 1897, at Susa (Tutt); July 22nd, 1897, at Ustedalen in Hol; July 30th, 1898, at Aal (Strand); July 26th-August 2nd, at Bourg St. Maurice, August 5th-15th, 1898, at Pré St. Didier (Tutt); June 21st-end of month, 1899, at Susa (Rowland-Brown); July 27th-August 6th, 1899, at Simplon; August 8th-15th, at Evolène; August 12th, in the Ferpècle Valley and on the Bricolla alp; August 16th-20th, 1899, at Arolla (Tutt); July 8th, 1899, at Sierre; very abundant, August 6th, 1899, at Bérisal (Wheeler); July 29th-August 7th, 1900, at Larche, August 9th-16th, at Abriès, August 20th-23rd, 1900, at Grésy-sur-Aix (Tutt); July 16th-August 5th, 1901, in the Cevennes (Rowland-Brown); July 30th-August 9th, 1901, at Torre Pellice, not common; August 9th-18th, 1901, at Bobbie; August 18th-22nd, 1901, at Au Pra (Tutt); August 7th-30th, 1901, in the Swiss Alps (Keynes); July, 1902, above Zermatt (Moss); July 19th, 1902, at Bérisal, with ab. *flava;* July 26th, 1902, on the Simplon; August 4th, 1902, on the Riffelberg (Sheldon); August 10th, 1902, at Megève; August 14th-16th, between Chamonix and Argentière; August 17th, above the Chapeau; August 18th, 1902, on the Brévent, to almost 7000 ft. (Tutt); August 7th, 1902, small and rather dull, at Vallorbe; August 8th, 1902, at Champéry; July 19th, 1903, at Bérisal (Wheeler); July 26th, 1903, at Vésubie (Rowland-Brown); July 28th, 1903, at Useigne; July 29th, between Evolène and Arolla; July 30th-August 12th, at Arolla; August 13th, between Evolène and Useigne; August 17th, above the Chapeau, Mer de Glace; August 18th, 1903, at Chamonix; July 28th-August 1st, 1904, on the Grand Salève; August 5th, 14th, at Stalden; August 6th-14th, 1904, in the Saas-Thal—Hüteck, Balen, Almagell, Saas-Grund to Saas-Fée, and Saas-Grund to Mattmark; August 15th-17th, in the Visp valley, between Stalden and Zermatt; August 16th, 1904, between Zermatt and the Schwarz See (Tutt); July 21st, 1904, on the Jebel-Barouk (Graves); June 19th-23rd, 1904, at Macolin (Lowe); July 14th, 1904, at Mendel; July 10th-August 5th, 1905, in the French Pyrenees (Rowland-Brown); July 29th-31st, 1905, at Grésy-sur-Aix; August 3rd-5th, at Bourg St. Maurice; August 9th-13th, at Pré St. Didier, Courmayeur, and the Val Véni; August 15th-18th, between Val Tournanche and Breuil; August 19th, at Chatillon; August 22nd, in the Val Anzasca (Tutt); July 3rd-9th, 1905, in the Kanderthal (Tetley). British records: September 5th, 1855, August 14th, 1856, at Hollingbury Combe (Image); end of August and first week in September, 1862, at Aylesbury (Parsons); August 10th, 1865, August 21st, 1896, at Hollingbury Combe (Image); August 4th-18th, 1878, at Boxhill (Whittle); August 2nd, 1884, three specimens taken at Danbury (*teste* Fitch); August 26th, 1888, at Boxhill (Whittle); August 4th-7th, 1890, at Chinnor (Spiller); July 16th, 1901, at Ranmore (Oldaker); August 20th, 1892, plentiful, and in good condition, at Boxhill (Waldegrave); August 4th, 1892, at Wimborne and Blandford (Bankes); July 6th, 1893, at Wendover (South); August 22nd, 1893, at Cuxton (Tutt); July, 1894, plentiful in the New Forest (Cox); July 9th-19th, 1894, on Canford Heath (Bromilow); August 3rd, 1894, at Park Down; August 27th, 1894, at Boxhill (Fletcher); very common and early, July 23rd, 1896, in the Guildford district (Grover); very abundant on the downs, August 1st and 3rd, 1896, near Reading (Hamm); August 3rd, 1896, at Reading

(Butler); August 2nd, 1897, at Shere near Dorking (Tremayne); August 2nd, 1897, at Reading (Butler); not common, and late, August 5th, 1897, in the Guildford district (Grover); common, first week in August, 1897, on the Berkshire downs (Clarke); August 1st, 1898, at Reading (Butler); July 29th, 1899, at Betchworth (James); August 3rd, 1899, in the neighbourhood of Kimble (Rowland-Brown); August 7th, 1899, rather worn, at Reading (Butler); August 14th, 1899, somewhat worn in the Gloucester district (Davis); between July 26th and September 10th, 1900, at Burgess Hill (Dollman); August 11th-27th, 1900, at Folkestone (Pickett); July 31st, 1901, at Reading (Butler); August 3rd-September 7th, 1901, at Burgess Hill (Dollman); August 3rd, 1901, at Aldbury Down (Barraud); August 23rd, 1901, August 27th, 1902, at Cuxton (Burrows); August 4th, 1902, in the Reading district (Butler); August 5th-27th, 1902, at Burgess Hill (Dollman); August 9th, 1902, at Aldbury Down (Barraud); August 8th, 1903, at Dover (Pickett); July 27th-30th, 1904, on Ranmore Common (Oldaker); August 1st, 1904, at Aldbury Down (Barraud); August 10th, 29th, 1904, at Cuxton (Burrows); August 14th, 1905, just out in the Gloucester district (Davis).

Habits.—The rapidity of the flight of *U. comma* is sufficiently remarkable; it skips rather than flies from flower to flower with surprising speed and agility, rarely resting on leaves, drawing up its wings rapidly and then darting off with the utmost despatch. Sometimes it chooses the ground on which to rest, and is then difficult to see, whilst it is, with *Hesperia alveus*, *Polyommatus damon*, *P. corydon*, etc., attracted to the wayside runnels in the Alps, drinking there, or at the muddy patches, with such evident gusto and forgetfulness that it then becomes an easy prey. It was in particular abundance at the dirty puddles and around the springs at Evolène in August, 1899, and at Simplon the same year, revelling in the hot steam rising from such places, and from any damp bank that faced the midday sun. At Cuxton, it particularly loves to sun itself on the capitula of a bright red dwarf thistle that is abundant there. The imaginal habit is to come to rest suddenly on a flower with its wings over its back, and it will keep this position sometimes for a considerable time. On the other hand, it will occasionally drop its wings almost at once, edging round so that the sun falls fully on its back, exposing its forewings to the sun. It usually, however, only depresses its forewings at first very little, and drops the hindwings but a little below them, in no wise approaching the horizontal, but, after a time, it drops the forewings to a considerable distance, at the same time lowering the hindwings still more, until they are nearly as horizontal as in the Thymelicids, and lower than we have ever noticed them in *Augiades sylvanus*. If disturbed, it suddenly raises its wings and darts off, sometimes to a considerable distance, usually taking up its position on a flower, of which, those of various species of thistles (*Carduus*), *Centaurea*, *Hieracia*, etc., are the most frequently chosen. Constant notes that it affects flowers of buckwheat around Autun. The males are pugnacious, attacking not only other individuals of their own species, but also driving off any other species that dares to approach too closely to its own chosen flower, to which it will sometimes return again and again if not disturbed by the observer. When asleep, the wings are drawn right up over the back, and there is no trace of a horizontal position being taken

by the hindwings. It sits boldly on the top of a flower in fine weather, but, in dull weather, hides well under the capitulum of some composite flower, and is then well protected. At Courmayeur, it haunts the thistles and scabious, and between Chamonix and Argentière it specially favours *Hieracia* flowers. During cloudy intervals, it sits closely on the flowers with its wings drawn up over its back, and Spiller notes that, at Chinnor, in the evening, when the sun is going below the horizon, this species delights to rest itself upon the flowerheads of the scabious, enjoying the warmth. Butler says that he has found several specimens, about 10 a.m., drying their wings, and apparently just emerged, in the Reading district. The imago is often infested with a brilliant scarlet parasite, which fixes itself externally to the abdominal incisions, and also to that between the thorax and abdomen, as well as the neck.

Habitat.—In Britain, the species appears to be confined to chalk-downs and limestone hills, and to be excessively local, abounding on the open sides of the hills and downs in suitable places, or in rough fields and lanes in chalky localities, *e.g.*, on the chalk downs in the Cuxton district (Tutt), Wendover district (Spiller), on the lower slopes of the downs at Shere near Dorking (Tremayne), plentiful on a particular patch at Ranmore about 100 yds. square (Oldaker), and on the chalk downs near Tring (Rothschild). On the continent, it is, in some places, exceedingly abundant, swarming in many places in the Alps of Central Europe, from the hot lowlying valleys to the utmost bounds of the flower-meadows of the highest alpine pastures, in fact, on the continent, it abounds at almost all elevations on sloping flowery banks, being particularly abundant on the flowery mountain pastures up to 6000ft. or 7000ft. elevation, reaching, in fact, a greater altitude than almost any other butterfly found at low elevations, being taken on the highest slopes with *Erebia glacialis*, *E. lappona*, *Colias phicomone*, and *Anthrocera exulans* at Arolla, and other similar localities. It abounds, too, sometimes, at the runnels by the sides of mountain-paths, drinking thirstily with *Polyommatus corydon*, *P. astrarche*, etc. Sometimes one finds it in lucerne meadows, and, above Grésy-sur-Aix at the end of July, 1905, we saw several specimens challenging *Augiades sylvanus* for a place at the clover blossoms, just emerged, however, whilst *A. sylvanus* was nearly over. At Wiesbaden, it haunts the open spaces in woods with *A. sylvanus* (Prideaux), and on the turf-covered sandbanks of the Althenthal in Finmark, Staudinger found it abundant, as well as on all the grassy flats of the low-lying country. It has a marvellous distribution, and the different character of its habitats can scarcely be imagined. From the sandy uplands of Finmark, the wastes of northern Siberia, and the sub-arctic regions of North America, to the mountains of the Sierra Nevada in Spain, the hot plains of Sicily and Italy, the low foothills of Spezia, the valleys of Corsica, through Asia Minor and Persia, up the Himalayas and mountains of central Asia to a height 12000 ft., along the Rocky Mountains to California, and across the continent to the Eastern States, will give habitats different enough if one will but consider the possibilities for a moment. In Germany, it is everywhere common in Thuringia in damp meadows, in the plains and on the foothills of the Thuringian Wald (Krieghoff), prefers damp meadows in the plains and on the foothills of Silesia (Wocke), in meadows where rushes grow in Carniola (Mann), same localities in Mecklenburg

as *A. sylvanus*, but on lighter soil, also on steep dry places at Ratisbon (Schmidt), extends to a great elevation in the Salzburg mountains, but is very abundant in the plains, and more widely distributed than *A. sylvanus* (Nickerl), from the lower part of the Inn valley to the region of the alpine meadows around Innsbruck (Weiler), and from the plain to the snowline throughout the Tyrolean Alps (Heller), in the Hufemoor, in Mecklenburg, at thistles (Tessmann), common in meadows near woods in Bohemia (Nickerl), in meadows near woods at Crefeld (Rothke), on the border of the Wulfsdorfer pinewood in Mecklenburg, at scabious flowers (Tessmann), common in meadows bordering woods in Nassau (Rössler), in clearings in woods near Hanau (Limpert), in openings in woods and on heaths in Oberhessen, in grassy places in woods and in meadows, in Waldeck (Speyer), in sunny grassy places in woods, on hedgebanks, etc., around Giessen (Glaser), prefers dry sunny grassy places and openings in the woods of Mosigkauer Haide in the province of Saxony (Amelang), everywhere common in meadows in Posen (Schultz), common in meadows and in bushy places in Silesia (Döring), and in meadows near woods and grassy places near Dresden (Steinert). Mrs. Nicholl says that this species is common throughout British Columbia, in the clearings in the forests, the examples here showing no variation from European specimens, except that they are rather smaller and darker than south European forms, and very like some from Norway.

British localities. — Quite unknown in Ireland, Scotland and Wales. Berks: Burghfield near Reading (Bird), Reading (Hamm). Bucks: Aston Clinton (Crewe), Halton (Greene), Kimble, generally common on Chiltern Hills between Princes Risborough and Wendover (Rowland-Brown), Wendover district (Spiller), Aylesbury (Bayne), Drayton Beauchamp (Rothschild). Cambridge: Newmarket Heath district (Bond), Fulbourn, Newmarket (Brown), Gogmagog Park (Morris), Devil's Ditch (Jenyns), [near Ely (Archer), very doubtful], Cambridge (Crisp). Devon: Sidmouth (Majendie), rare—Plymouth, Exmouth (Reading), near Exeter, rare (Parfitt). Dorset: Wimborne, Blandford (Bankes), Badbury Rings (Dale), Hambledon Hill (Fowler), Gussage, between Blandford and Wimborne (Ward), Sherborne (Douglas), Bournemouth—Canford Heath (Bromilow). Essex: Danbury, three specimens (Fitch), Saffron Walden (*teste* J. Clarke). Gloucester: scarce and local (Hudd), Rodborough Common (Musgrave), Cotswolds (Harrison), Cheltenham district (*teste* Edwards), Painswick (Merrin), Stroud (Stephens), Great Witcombe (Newstead). Hants: on hills round Winchester (Hewett), Farley Mount (Johns), Portsdown (Buckler), Kimpton (Rudd), Petersfield (Moncreaff), Lyndhurst (Cox), Paulsgrove, Portsdown Hill (Pearce). Herts: Tring district — Aldbury Downs (Barraud), Roman Road, Haileybury (Stockley), Dancers End (Rothschild). Kent: not common in the south-east of Kent (Freke), fairly plentiful but very local at Herne Bay (Battley), Chatham (Tyrer), Cuxton Downs, Paddlesworth, Boxley Warren (Walker), Folkestone (Pickett), Dover (Tutt), Boxley Hills near Maidstone (Greensted), Maidstone district (Golding), Shoreham (Carr), Kingsdown to St. Margaret's Bay (Shepherd), Wye district (Parry), Ashford district, local (Wood), Herne Bay (Butler). Lancashire: Windermere district, near the Ferry Hotel (Moss). Middlesex: [Hanwell Heath, near Ealing (Harris),] Kingsbury, Old Oak Common (Godwin). Norfolk: Swaffham (Atmore). Northampton: Barnwell Wold, Ashton Wold (Morris), Bullnose Coppice (Bree). Oxford: Chinnor (Spiller). Somerset: scarce and local (Hudd), Weston (Vaughan), Brockley (Last). Stafford: Chartley, single specimen only (Freer). Suffolk: very local, Newmarket Heath, etc. (Brown). Surrey: Dorking, Ranmore (Oldaker), Riddlesdown near Croydon (Stephens), Boxhill (Machin), Betchworth (James), Shere near Dorking (Tremayne), Guildford (Grover), Park Down (Fletcher), Horsley (Carr), Croydon (Hall), Reigate, locally common (Tonge), hills east of Guildford (Cockerell). Sussex: Burgess Hill district (Dollman), East Sussex, locally common—Brighton, Lewes, Polegate, Eastbourne, Malling Hill, etc. (Jenner), Hollingbury Coombe (Buckler), Bible Bottom, Cliff Hill (Levitt). Wilts:

Old Sarum (Dale), Martinsell (Preston), common on Salisbury Plain (Carr). Yorks: Scarborough (Birchall), Brantinghamthorpe (Stather *teste* Hewett), Bishop's Wood (Grassham), York (*teste* Newman), near Hull (*teste* Dale).

Distribution.—The whole Palæarctic region, except Mauretania and the Canary Isles (Staudinger); northern United States, Pacific States, Rocky Mountains (Dyar); Dominion of Canada, from Vancouver to Quebec (Scudder). America: (see *anteà*, pp. 162-174). Asia: Central Japan —Yesso, etc. (Leech), Corea (Hertz), Nicolaiefsk (Rühl), Siberia—Ost-Sajan (Staudinger), the western Pamirs (Romanoff), Saisan (Rühl), northwest Himalayas (Nicéville), Persia—Astrabad, Anatolia (Rühl), Asia Minor—Amasia—top of the Lokman, etc. (Fountaine), Syria—Taurus, Berud-Dagh (Delagrange), etc. Austro-Hungary: Everywhere more or less distributed (Höfner), Galicia (Garbowski), Bohemia—Carlsbad (Hüttner), Prague, Senftenberg (Fritsch), Moravia, distributed—Brünn, Neutitschin, Rottalowitz, Troppau (Fritsch), Upper Austria, throughout (Brittinger)—Kirchdorf, Linz (Fritsch), Lower Austria—Vienna (Rossi), Hernstein district (Rogenhofer), Gresten (Fritsch), Salzburg (Richter), Tyrol, lowlands and up to 7000ft., common (Hinterwaldner)—Glockner district, Bozen, Trient, Dolomite district — Val Popena, Cortina (Mann), Brenner district — Tienzins, Mauera (Galvagni), Mendel (Tutt), Innsbruck, up to 7500 feet, Taufers (Weiler), Enns district (Brittinger), Bregenz (Tutt), Schlucken-Alpe, Stanser-Joch, Obergurgl, Knutten, Seiser-Alpe, Mandron-Alpe, Stilfser-Joch (Heller), Ortler district, Gastein (Rühl), Carniola (Mann), Upper Carinthia (Nickerl)— St. Jakob (Fritsch), Wolfsberg, Heiligenblut, etc. (Lemann), Croatia—Josefsthal (Mann), Slavonia—Lipnik, Dalmatia, Banat, Transsylvania—Alterberg (Rebel), Hungary—Biala, Kaschau (Fritsch), Eperies (Aigner), Buda-Pest district (Nicholson), Fünfkirchen, Friesach (Rühl). Belgium: locally common — Montagne St. Pierre, Mons, very rare (Donckier), Ortho, common (Slégers), near Hastière (Hugge), Dinant (Lenoir), Anhée, Warnant, Namur, very rare (Lambillion), Rochefort (Carlier), Bouillon (Wautier), Virton (Sibille), Vallée de la Lesse, common (Bodart). Bosnia: local—Zepce (Werner), Fojnica (Simonys), Trebevic (Rebel), Trescavica (Apfelbeck), Kalinovik (Schreitter). Bulgaria and Eastern Roumelia: near Sophia (Bachmetjew), Rilo district—Rilska Valley (Nicholl), Rustschuk, Slivno—Bjela, rare (Haberhauer). Channel Isles: Jersey, common (Luff). Corsica (Kollmorgen). Denmark: distributed (Bang-Haas). Finland: south and south-east (Lampa)— Solovetsk, Kaschkarantsa, Tschavanga (Reuter). France: throughout locally (Tutt), Rennes, Ille-et-Vilaine—the coast from Cancale to St. Malo, Monterfil (Oberthür), Vannes, Ploërmel (Griffith), Eure—Pont de l'Arche (Dupont), Elbeuf (Coulon), Paris district, St. Germain-en-Laye, Fontainebleau, Lardy, Vosges (Berce), Doubs— Besançon (Bruand), Calvados—Mont d'Eraines (Moutiers), Aube—Les Riceys, Lusigny (Jourdheuille), Indre—Brenne (Martin), Manche — near Cherbourg (Nicollet), Saône-et-Loire—near Autun (Constant), Auvergne district— Forêt de Chateauroux, Forêt d'Allogny, Mt. Dore, Le Chambon, Le Lioran (Sand), Lozère —Balsièges (Rowland-Brown), Charente — Angoulême (Dupuy), Loir-et-Cher (Bellier), Savoy—Lanslebourg (Oberthür), Grésy-sur-Aix, Bourg St. Maurice, Annecy, Megève, between Chamonix and Argentière (Tutt), Gironde (Brown), Aude (Mabille), Loire-Inférieure—Orvault (Bureau), Dauphiné Alps—St. Michel, Le Lautaret, La Grave, etc., Hautes-Alpes—Abriès, etc., Basses-Alpes—Larche, etc. (Tutt), Digne (Oberthür), French Pyrenees—Cauterets, Le Vernet (Oberthür), Pierrefitte-Nestalas (Jones), Alpes-Maritimes, abundant (Bromilow)—Rte. de Venanson, St. Martin Vésubie (Rowland-Brown), Haute-Garonne (Caradja), Maine-et-Loir (Roy), Haute-Marne—Varennes, Bourbonne (Frionnet), Dordogne—Queysac (Tarel), Gironde— env. Bordeaux (Brown). Germany: Prussia, common—Rastenburg, Insterburg, Willenberg (Schmidt), Cranz, Tilsit, Rauschen, Warnicken, Capornsche Haide, Dammhoff, Königsberg, Löwenhagen, Tapiau, Wehlau, Norkitten, Beynuhnen, Darkehmen, Landsberg, Quittainen, Mohrungen, Osterode, Gr. Bertung, Dantzig, etc. (Speiser), Pomerania—everywhere (Paul and Plötz), Mecklenburg—Neustrelitz, Rülow, Sülze, Wismar (Schmidt), Lübeck (Tessmann), Schwerin, Parchim (Gillmer), Friedland (Stange), Schleswig-Holstein, etc., not rare—Eutin (Dahl), Hamburg (Beske), Altona (Tessien), Heligoland (Dalla Torre), Hanover—Bremen (Rehberg), Lüneburg (Machleidt), Hanover (Reinhold), Osnabrück, Hameln, Osterode, Göttingen (Jordan), Brunswick, etc. — Brunswick, Wolfenbüttel (Heinemann), Helmstedt, Quedlinburg (Jordan), Unterharz (Gillmer), Westphalia—Münster (Speyer), Höxter (Jordan), Rhine Provinces—Crefeld, Aix, near Hitfeld (Stollwerck), Elberfeld (Weymer), Neuenahr (Maassen), Hesse-Nassau, etc. — Wiesbaden (Rössler), Oberursel (Fuchs), Hanau (Limpert),

Vogelsberg, Giessen (Glaser), Frankfort-on-Main (Koch), Cassel (Borgmann), Waldeck (Speyer), Rotenburg-on-Fulda (Jordan), Biedenkopf (Jäger), Thuringia—in the plains and hills (Krieghoff), Erfurt (Keferstein), Rudolstadt (Jordan), Saxony—Zeitz-on-Elster, Knittelholz, Ossig (Wilde), Halle (Stange), Dessau (Richter), Cöthen (Gillmer), Mühlhausen, Naumburg, Nordhausen, Sondershausen, etc. (Jordan), Brandenburg, somewhat common (Pfützner)—Berlin district (Bartel), Niederneundorf (Dadd), Frankfort-on-Oder (Kretschmer), Posen—throughout (Schultz), Silesia—Brieg (Döring), Reinerz (Standfuss), Trebnitzer-Gebirge (Nohr), Upper Lusatia (Möschler), Sprottau district—Oberleschen, etc. (Pfitzner), Saxony—Dresden (Steinert), Saxon Upper Lusatia (Schütze), Freiberg (Fritzsche), Chemnitz (Pabst), Leipzig (Speyer), Bavaria—Regensburg (Hofmann), Munich (Kranz), Augsburg (Freyer), Kempten (von Kolb), Württemberg, throughout (Seyffler), Baden throughout (Reutti), Alsace (Meess), the Palatinate (Bertram). Greece: Parnassus (Staudinger). Italy: Lombardy (Turati), Piedmont—Courmayeur, Pré St. Didier, Val Véni, Susa, Torre Pellice, Au Pra, Bobbie, Val Tournanche, Cogne, etc. (Tutt), Certosa di Pesio (Norris), Pistoiese Apennines (Verity), near Boscolungo (Norris). Tuscany—throughout, Abruzzi, etc. (Stefanelli), Sicily—Osimo (Spada), Madonie Mountains at 1600m., San Martino, Partenico (Struve), Fuligno (Zeller), Gerace (Calberla), Spezia (de la Garde). Netherlands: very rare (Snellen), Breda (Heylærts). Roumania: generally distributed—Valeni, Dulcesti (Caradja), Grumazesti (Fleck). Russia: Baltic Provinces, throughout (Nolcken), Caucasus district (Bramson), Dorpat, St. Petersburg, Moscow, Kaluga, Kasan, Gorki (Rühl), Lower Volga district, Baschkiria, near Sarepta (Eversmann), Derbent (Rühl). Scandinavia: Sweden, throughout—Lapland, rare, etc., Norway—south, also Dovre, Finmark, Hunneberg district (Lampa), Sopnes, Kaafjord, Nordreisen, Ose, Hœgstoïl, Aal, Ustedalen in Hol (Strand), Talrig, Bossekop (Zetterstedt), Romsdal, near Stueplaten (Jordan). Pier, Fron, Gudbrandsdal, Tyldal, Jerkin, Kongsvold, Nystuen, Romsdal-Naes (Siebke). Servia (Lazarewitsch). Spain: Sierra Nevada (Rambur), Barcelona district (Martorell), Cote de Huejar (Graslin), Tragacete, Albarracin (Chapman), Bilbao (Rössler). Switzerland: common and generally distributed (Frey), Rhone Valley—Sierre, etc., Bérisal (Wheeler), Simplon Valley, Val d'Hérens—Useigne, Evoléne, Villar, Haudères, Arolla, Saas-Thal—Stalden, Hüteck, Saas-Grund to Mattmark, Saas-Fée, etc., Visp-Thal—Stalden to Zermatt, etc. (Tutt), Val d'Anniviers (Rowland-Brown), Riffelberg (Sheldon). Champéry, Vallorbe (Wheeler), Macolin (Lowe), above Gletscher Alp (Rowland-Brown), Roseg Valley (Nicholson), Oberalp (Chapman), Pontresina (Lemann), Grisons—Bergün, Ponte (Rühl), Berne—Kanderthal (Tetley), Mount Chemin, Bâtiaz, Martigny, Varône, Loèche, the Gemmi, Aletsch Forest, the Grimsel, Mayenwand, Schallberg, the Gorner Grat, etc. (Favre), the Pfynwald (Rosa). Turkey (Rebel).

## Family: Cyclopididæ.

This family is a very comprehensive one, and appears to fall into at least two important subfamilies on neurational characters, according to Watson, *viz.* (1) *Trapezitinae*, (2) *Cyclopidinae*. The former is the *Trapezitae*, and the latter, the *Cyclopidae* of Hübner (*Verzeichniss*, pp. 111-112). The former is diagnosed in the imaginal stage by Watson, as having "Nervure 5 of forewing slightly nearer to 6 than to 4," whilst the latter is noted as having "Nervure 5 not nearer to 6 than to 4, usually distinctly nearer to 4 than to 6." The latter is then divisible into two very characteristic tribes: (1) With epiphysis on fore tibiæ present—*Amblyscirtidi*, (2) The epiphysis not present—*Cyclopididi*. The latter contains our characteristic Palæarctic genera—*Heteropterus* (type *morpheus*) and *Cyclopides* (type *palaemon*). In the *Cyclopididae*, the ♂ has very rarely a discal stigma on the forewing, but frequently presents glandular patches or tufts of hair on the wings, whilst there appears never to be a tuft of hair on the tibiæ of the hind legs; the epiphysis on the tibiæ of the front legs, and the median pair of spurs of the tibiæ of the hind legs are also sometimes wanting, a remarkable character in this superfamily. The family is confined almost entirely to the Old World, although some of the

*Cyclopididi* have a great range in the Palæarctic and Nearctic areas. The family is diagnosed under the name *Pamphilinae*, Sect. A, by Watson (*Proc. Zool. Soc. Lond.*, 1893, p. 69), as follows :—

Antennæ very varied, never much hooked, and usually sharply pointed. [In all the genera, in which the tip of the antennæ is blunt, the epiphysis on the fore tibiæ is wanting, excepting in one or two Australian forms.] The palpi have the third joint usually short and inconspicuous, in some few genera long and slender, in these it is always erect and never porrected horizontally in front of the face. Forewing with cell always less than two-thirds the length of costa; nervure 5 slightly nearer to 4 than to 6, except in some aberrant Australian forms, in which it is slightly nearer to 6. Hindwing never with a conspicuous tail or tooth, though frequently more or less lobate; nervure 5, never well developed.

## Subfamily: Cyclopidinæ.

### Tribe: Cyclopididi.

The tribe containing our representative Palæarctic genera (*Heteropterus* and *Cyclopides*) is tabulated by Watson as follows :—

*a*. Vein 5 of forewing not nearer to 6 than to 4, usually distinctly nearer to 4 than to 6.
  *b*. No epiphysis on fore tibiæ.
    *c*. Antennæ, short, less than half the length of the costa.
      *d*. Vein 11 of forewing free.
        *e*. Club of antenna arcuate, tip acuminate—Eumesia, Feld. (Type *semiargentea*, Feld.)
        $e_1$. Club of antenna straight, tip blunt.
          *f*. Vein 3 of forewing well before end of cell; vein 2 nearer to base of wing than to end of cell—Heteropterus, Dum. (Type *morpheus*, Pall.)
          $f_1$. Vein 3 of forewing immediately before end of cell; vein 2 nearer to end of cell than to base of wing —Cyclopides, Fabr. (Type *palaemon*, Pall.)
      $d_1$. Vein 11 of forewing running into 12—[Watsonia nov. gen.] (Type *metis*, Linn.)

The tribe is noted by Speyer (*Can. Ent.*, x., p. 150) as being characterised, so far as the Palæarctic genera are concerned, as follows :—

The tibial epiphysis of the front legs wanting. Club of antenna elongate-oval, terminating conically, slightly curved. Apical joint of palpi conical, projecting, almost horizontal. Tibiæ armed with spines, at least the middle ones. Abdomen longer than the head and thorax united, the posterior wings uplifted. Male without the costal fold, the stigma, and the tuft on the tibiæ.

In our preceding larval descriptions, we have frequently referred to the peculiar structures called "lenticles," which are found in this stage in the Urbicolids. As it was in *mandan*, one of the American forms of *C. palaemon*, that these were first noticed, we may here add Fletcher's remarks thereon. He notes (*Can. Ent.*, xxi., p. 115) them as small rounded chitinous disks, which appear to be trichomes or modified hairs, an opinion formed on the fact that, in one species (observed later), there occurred in two instances, instead of these disks, piliferous tubercles; he adds that they are small and difficult to examine; in *C. mandan* they appear to be saucer-shaped, having a raised edge; in a species of *Pamphila* (near *manitoba*), they are, in some instances, simple annuli, but, in *P. cernes* and *P. mystic*, seem to be rather cone-shaped. Similar lenticles were observed on the pupa of *P. cernes*.

## Genus: Cyclopides, Hübner.

Synonymy.—Genus: **Cyclopides**, Hb., "Verz.," p. 110 (1816); Stphs., "Ill. Haust.," iv., p. 405 (1834); Humph. and Westd., "Brit. Butts.," p. 124, pl. xxxix.,

figs. 6-9 (1841); Stphs., "List," etc., 1st ed., p. 22 (1850); Westd. and Hewits., "Gen. Diurn. Lep.," p. 520 (1852); Stphs., "List," etc., 2nd ed., p. 20 (1856); Kirby, "Eur. Butts.," p. 124 (1862); Butl., "Cat. Diurn. Lep.," p. 278 (1869); Edw., "Trans. Am. Ent. Soc.," iii., p. 196 (1871); Scudd., "Syst. Rev. Am. Butts.," p. 54 (1872); Kirby, "Eur. Butts.," p. 64 (1882); Dale, "Brit. Butts.," p. 208 (1890); Barr., "Lep. Brit. Isl.," p. 298, pl. xl., figs. 1-1*d* (1893). **[Papilio-Plebeius-] Urbicola,** Pall., "Reise," etc., i., p. 471 (1771); Fab., "Sys. Ent.," p. 531 (1775); Sulzer, "Abgekürzte Ges. Ins.," p. 147, pl. xix., figs. 8-9 (1776); Esp., "Schmett. Eur.," i., pl., xxviii. (suppl. iv.), fig. 2 (1777), p. 322 (1779), pl. xcv. (contd. L.), fig. 5 (var.) (1787); p. 14 (1796); Bergstr., "Nomenclatur," etc., p. 40, pl. xci., figs. 7-8 (1780); Goeze, "Ent. Beit.," ii., pt. 3, p. 112 (1780); Fab., "Spec. Ins.," pt. 2, p. 131 (1781); "Mant.," ii., p. 85 (1787); Bork., "Sys. Besch.," i., pp. 183, 286 (1788); ii., p. 236 (1789); Brahm, "Ins. Kal.," ii., p. 239 (1791); Haw., "Lep. Brit.," p. 49 (1803). **Papilio,** Schiff., "Sys. Verz.," 1st ed., p. 160 (1775); Schneider, "Sys. Besch. Eur. Schmett.," p. 280 (1785); Don., "Brit. Ins.," vii., pl. 254, fig. 1, p. 7 (1799); Hb., "Eur. Schmett.," pl. xciv., figs. 475-6 ♂ (1802); text, p. 71 (*circ.* 1805); "Larv. Lep.," i., Pap. ii., Gens E.*c.*, figs. 1-1*a* (? foodplant = *Plantago*) (*circ.* 1800); Ill., "Schmett. Wien.," 2nd ed., ii., p. 147 (1801); Ochs., "Die Schmett.," i., pt. 2, p. 219 (1808); Freyer, "Neu. Beit.," vi., p. 52, pl. 513, fig. 1 (1852); vii., p. 47, pl. 626, fig. 1 (1858). **[Hesperia-] Urbicola,** Fab., "Ent. Sys.," iii., pt. 1, p. 328 (1793). **Hesperia,** Latr., "Hist. Nat.," xiv., p. 124 (1805); "Consid. Gen.," p. 208 (1810); Leach, "Edin. Encyl.," ix., p. 130 (1815); Ochs., "Die Schmett.," iv., p. 34 (1816); Dalm., "Vet. Ak. Handl.," xxxvii., p. 201 (1816); Latr., "Enc. Méth.," p. 773 (1819); Sam., "Ent. Comp.," p. 243 (1819); Godt., "Hist. Nat.," i., p. 231, pl. xii., fig. 2 (1821); Bdv., "Eur. Lep. Ind. Meth.," p. 26 (1829); Meig., "Eur. Schmett.," p. 65, pl. xxxv., figs. 6*a-d* (1829); Treits., "Die Schmett.," x., p. 248 (1834); Evers., "Faun. Volg.-Ural.," p. 86 (1844); Dup., "Icon. Chen.," p. 215, pl. xxxi., fig. 91 (? foodplant) (1849); Spey., "Geog. Verb.," p. 283 (1858); Edw., "Proc. Entom. Soc. Phil.," ii., pp. 20-21, pl. v., fig. 1 (1863); Scudd., "Proc. Bost. Soc. Nat. Hist.," xi., pp. 383-384 (1868); Newm., "Brit. Butts.," p. 171 (1869); Gillm., "Archiv. Ver. Naturges. Meckl.," 1904, p. 117 (1904). **Pamphila,** Fab., "Ill. Mag.," p. 287 (1807); Oken, "Lehrb. Zool.," iii., pt. 1, p. 759 (1815); Stphs., "Ill. Brit. Ent.," p. 100 (1828); Stphs., "Ins. Cat.," p. 27 (1829); Wood, "Ind. Ent.," p. 9, fig. 77 (1839); Gosse, "Can. Nat.," p. 219 (1840); Scudd., "Butts. of East. Un. States," ii., p. 1569 (1889); Watson, "Proc. Zool. Soc. Lond.," p. 89 (1893); Kirby, "Handbook," etc., p. 16 (1897); Staud., "Cat.," 3rd ed., p. 91 (1901); Lamb., "Pap. Belg.," p. 263 (1902). **Steropes,** Bdv., "Gen. et Ind. Meth.," p. 34 (1840); Dup., "Cat. Meth.," p. 35 (1840); Dbldy., "Syn. List.," p. 2 (1850); Sta., "Man.," i., p. 66 (1857); Grote, "Proc. Sth. Lond. Ent. Soc.," p. 59 (1897). **Carterocephalus,** Led., "Verh. zool.-bot. Gesell.," ii., p. 26 (1852); Staud., "Cat.," 1st ed., p. 15 (1861); Snell., "De Vlind.," p. 84 (1867); Nolck., "Lep. Fn. Estl.," p. 84 (1868); Staud., "Cat.," 2nd ed., p. 35 (1871); Curò, "Bull. Soc. Ent. Ital.," vi., p. 217 (1874); Streck., "Lep.," p. 69 (1874); Edw., "Cat. Lep. Amer.," p. 49 (1877); Frey, "Lep. Schweiz," p. 55 (1880); Lang, "Butts. Eur.," p. 356, pl. 82, fig. 5 (1884); Kane, "Eur. Butts.," p. 149 (1885); Auriv., "Nord. Fjär.," p. 38, pl. vii., fig. 11 (1889); Bean, "Can. Ent.," xxv., pp. 145-147 (1893); Rühl, "Pal. Gross-Schmett.," p. 632 (1895); Tutt, "Brit. Butts.," p. 140 (1896). **Heteropterus,** Wallgrn., "Skand. Dagf.," p. 254 (1853); Kirby, "Syn. Cat.," p. 624 (1871). **Cyclopædes,** Hein., "Schmett. Deutsch.," p. 115 (1859); Meyr., "Handbook," etc., p. 357 (1895). **Steroptes,** Edw., "Trans. Am. Ent. Soc.," iii., p. 214 (1871).

This name was first used by Hübner (*Verzeichniss*, p. 111) for five heterogeneric species, and was described as follows:—

Die Flügel oben gelbfleckig, unten zierlick braun gezeichnet—*Cyclopides steropes*, Schiff. (*aracinthus*, Fab., Hübn.); *C. brontes*, Schiff. (*paniscus*, Fab., Hübn.); *C. silvius*, Knoch, Hubn.; *C. metis*, Linn., Cram.; *C. coras*, Cram.

In 1834, Stephens restricted the genus to *paniscus*, Fab., and *sylvius*, Knoch, but, subsequently, in 1850, fixed the type as *paniscus*, Fab., which was confirmed by Westwood and Hewitson, in 1852. The later name of *Carterocephalus*, created by Lederer, to replace the preoccupied *Steropes*, falls as a synonym of Hübner's much older

name, having the same type (*paniscus*, Fab., *palaemon*, Pallas). It is described by Speyer (*Can. Ent.*, x., p. 150) as follows:—

Antennæ equal to half the length of the forewings with elongate ovoid club. Apical joint of the palpi slender, conical, moderately acute, quite concealed by the long hairs of the middle joint. Body moderately robust, with thickly-haired (in *argyrostigma*, also very long hair) abdomen. Surface of the wings more hairy, with, notably, a conspicuous streak of still longer and thicker prominent hairs along the inner margin of the abdominal suture of the hindwings—*palaemon*, Pall.; *silvius*, Knoch; *argyrostigma*, Ev.

This was very much extended by Watson, who, under the name of *Pamphila*, described the genus as follows:—

Antennæ short, not half the length of the costa, club stout, elongate, blunt. Palpi porrect, densely clothed with laxly-set scales, almost concealing the third joint, which is short, slender, and bluntly conical. Forewing with the inner margin considerably longer than outer margin; cell less than two-thirds the length of costa; vein 12 reaching costa before the end of cell; upper discocellular short, but distinct, outwardly oblique; middle discocellular slightly longer than lower; vein 5 slightly nearer to 4 than to 6; vein 3 very close to end of cell; vein 2 almost equidistant from base of wing and end of cell, hindwing with outer margin even; cell very long, reaching more than half across the wing; vein 7 shortly before end of cell; discocellulars and vein 5 barely traceable; vein 3 immediately before end of cell; vein 2 considerably nearer to end of cell than to base of wing. No epiphysis on fore tibiæ. Hind tibiæ slightly pronged and with only terminal pair of spurs—*palaemon*, Pall. (*paniscus*, Fabr.; *brontes*, Schiff.); *mandan*, Edw.; *mesapano*, Sc.; *sylvius*, Knoch (*sylvicola*, Meig.); *argyrostigma*, Evers.

As here restricted, the genus contains only two European, one Siberian and two North American, species. Rühl (*Pal. Gross-Schmett.*, pp. 630 *et seq.*) adds *christophi*, Grum-Grsh.; *gemmatus*, Leech; *dieckmanni*, Graes. and *ops*, Grum-Grsh. It is to be noted that, at least, the two European species of the genus are almost identical in their biological details. The eggs are practically identical, the larvæ are grass-feeders, they hybernate as fullgrown larvæ pupating in the late spring, and emerge in about three weeks, both species appearing at the same period of the year. A detailed comparative study of these species is much needed. [See Gillmer, *Arch. d. Ver. d. Fr. d. Naturgesch. in Meckl.*, 1904, pp. 117 *et seq.*; *Soc. Ent.*, xx., pp. 161-163.]

## Cyclopides palæmon, Pallas.

Synonymy.—Species: **Palæmon,** Pallas, "Reisen.," etc., i., p. 471 (1771); Kirby, "Syn. Cat.," p. 624 (1871); Staud., "Cat.," 2nd ed., p. 35 (1871); Curò, "Bull. Soc. Ent. Ital.," vi., p. 217 (1874); Kirby. "Eur. Butts.," p. 64 (1882); Lang, "Butts. Eur.," p. 356, pl. 82, fig. 5 (1884); Kane, "Eur. Butts.," p. 149 (1885); Auriv., "Nord. Fjär.," p. 38, pl. vii., fig. 11 (1889); Watson, "Proc. Zool. Soc. Lond.," p. 89 (1893): Rühl, "Pal. Gross. Schmett.," p. 632 (1895); Meyr., "Handbook," etc., p. 357 (1895); Tutt, "Brit. Butts.," p. 140 (1896); Kirby, "Handbook," etc., p. 16 (1897); Staud., "Cat.," 3rd ed., p. 91 (1901); Lamb., "Pap. Belg.," p. 263 (1902). **Paniscus,** Fab., "Sys. Ent.," p. 531 (1775); Sulzer, "Abgekür. Ges. Ins.," p. 147, pl. xix., figs. 8-9 (1776); Esp., "Schmett. Eur.," i., pl. xxviii. (supp. iv.), fig. 2 (1771); p. 322 (1779); pl. xcv. (contd. L.), fig. 5 (1787); p. 14, *var.* (1796); Goeze, "Ent. Beit.," ii., pt. 3, p. 112 (1780); Bergs., "Nomenclatur," etc., p. 40, pl. xci., figs. 7-8 (1780); Fab., "Spec. Ins.," pt. 2, p. 131 (1781); Schneid., "Sys. Besch. Eur. Schmett.," p. 280 (1785); Fab., "Mant.," ii., p. 85 (1787); Bork., "Sys. Besch.," i., pp. 183, 286 (1788); ii., p. 236 (1789); Brahm, "Ins. Kal.," p. 239 (1791); Fab., "Ent. Sys.," iii., pl. 1, p. 328 (1793); Don., "Brit. Ins.," vii., p. 7, pl. 254, fig. 1 (1799); Ill., "Schmett. Wien.," 2nd ed., p. 14 (1801); Haw., "Lep. Brit.," p. 49 (1803); Latr., "Hist. Nat.," xiv., p. 124 (1805); Fab., "Ill. Mag.," p. 287 (1807); Ochs., "Die Schmett.," i., pt. 2, p. 219 (1808); Latr., "Consid. Gen.," p. 208 (1810); Leach, "Edin. Ency.," ix., p. 130 (1815); Oken, "Lehrb. Zool.," iii., pt. 1, p. 759 (1815); Ochs., "Die Schmett.," iv., p. 34 (1816); Dalm., "Vet. Ak. Handl.,"

xxxvii., p. 201 (1816); Latr., "Enc. Méth.," p. 773 (1819); Sam., "Ent. Comp.," p. 243 (1819); Godt., "Hist. Nat.," i., p. 231, pl. xii., fig. 2 (1821); Stphs., "Ill. Brit. Ent.," i., p. 100 (1828); Bdv., "Eur. Lep. Ind.," p. 26 (1829); Stphs., "Ins. Cat.," p. 27 (1829); Meig., "Eur. Schmett.," p. 65, pl. lv., figs. 6*a*-*d* (1830); Treits., "Die Schmett.," x., p. 248 (1834); Stphs., "Ill.," iv., p. 405 (1834); Wood, "Ind. Meth.," p. 9, fig. 77 (1839); Bdv., "Gen. et Ind. Meth.," p. 34 (1840); Dup., "Cat. Meth.," p. 35 (1840); Humph. and Westd., "Brit. Butts.," p. 124, pl. xxxix., figs. 6-9 (1841); Evers., "Faun. Volg.-Ural.," p. 86 (1844); Dup., "Icon. Chen.," p. 215, pl. xxxi., fig. 91 (? see foodplant) (1849); Stphs., "List," 1st ed., p. 22 (1850); Dbldy., "Syn. List," p. 2 (1850); Westd., and Hewits., "Gen. Diurn. Lep.," p. 520 (1852); Led., "Verh. zool.-bot. Gesell.," ii., p. 26 (1852); Stphs., "List," 2nd ed., p. 20 (1856); Sta., "Man.," i., p. 66 (1857); Speyr., "Geog. Verb.," p. 283 (1858); Hein., "Schmett. Deutsch.," p. 115 (1859); Staud., "Cat.," 1st ed., p. 15 (1861); Kirby, "Eur. Butts.," p. 124 (1862); Wallgrn., "Skand. Dagf.," p. 254 (1853); Snell., "De Vlinders," p. 84 (1867); Nolck., "Lep. Fn. Estl.," p. 84 (1868); Butl., "Cat. Diurn. Lep.," p. 278 (1869); Newm., "Brit. Butts.," p. 171 (1870); Frey, "Lep. Schweiz," p. 55 (1880); Dale, "Brit. Butts.," p. 208 (1890); Barr., "Lep. Brit. Isl.," p. 298, pl. xl., figs. 1-1*d* (1893); Bean, "Can. Ent.," xxv., pp. 145-147 (1893). **Brontes,** Schiff., "Schmett. Wien.," 1st ed., p. 160 (1775); Hb., "Eur. Schmett.," pl., xciv., figs. 475-6, ♂ (1802); text, p. 71 (*circ.* 1805); "Larvæ Lep.," i., Pap. ii., Gens E.c., figs. 1-1*a* (*circ.* 1800).

Original description.—*Papilio Plebeius Urbicola palaemon.* Magnitudo et facies *Papilionis metis.* Alæ supra fuscæ, maculis crebris luteis, primores magis minusue confluentibus, secundarie tribus majoribus disci et per ambitum circiter senis. Subtus color e luteo cinerascit, maculæ priorum magis confluunt, in secundariis vero maculæ pallidæ, linea fuscescente inclusæ, binæ ad basin, dein ternæ, et fascia ambitus subinterrupta. β. Varietas datur, tota aurea, fimbriis atris, sed secundariarum tamen extrema ora flavis; maculæ nigræ disci primorum utrinque difformes quatuor et series punctorum versus marginem; reliqua, ut in specie (Pallas).

Imago.—27mm.-30mm. Anterior wings rather narrow, apex pointed; ground colour deep brown, thinly dusted with yellow scales, and conspicuously marked with squarish yellow spots—two in discal cell, one below these directly under median nervure, one inner marginal near base—beyond the middle a conspicuous angulated row from costa to inner margin, an outer marginal row of small interneural spots; fringes pale yellowish, inner half darker. Posterior wings with similar ground colour and spots, the latter analogous with those on forewing, usually one towards base, two median, an outer transverse row (analogous with angulated row of forewing); the interneural marginal series absent or inconspicuous; fringes as in forewings.

Sexual dimorphism.—There is practically no sexual dimorphism. The ♀ is perhaps a little paler than the ♂. Raynor observes that 18 out of 20 ♀s in his series are distinctly larger than the average size of the ♂s.

Genitalia.—The ♂ genital apparatus has the upper organ with the centrum a little convex, slightly compressed; hooks as long as centrum, and together as broad as the base, regularly conical, straight, bent strongly downward. Clasps about two and a quarter times longer than broad, quite as broad at apex as at base, the upper edge sinuous; apical tooth small, compressed, laminate, not pointed, central, interior, curved slightly inward (Described from North American specimens of the var. *mandan*). The genitalia of the North American form appear to differ from those of the European *palaemon* in that the apical tooth of the clasp is bent inward a little less, in the greater stoutness of the upper organ and of each of the parts, and in having the hooks much more

strongly bent downward, forming a considerable angle with the lateral arms (Scudder, *Butts. of New England*, ii., p. 1571).

Teratological specimen.—♂. The right hindwing about half the normal breadth, the tornal area much reduced and the termen very oblique. Taken at Newball, June, 1894 (Hampson, *Ent. Mo. Mag.*, xxxvii., p. 120).

Variation.—There is little difference in the depth of the ground colour, but considerable in the intensity and size of the spots, and the marginal row of small dots varies from almost total absence to a distinctly united series. Of the spots on the forewings the three median spots, two in the cell and one directly below the nervure, are usually joined into a rough V-like mark, and occasionally the inner-marginal basal spot unites with the lower of the angulated series, making a distinct mark along the inner margin; it is rare that the upper spots of the angulated series are joined, although the lower ones almost always are. On the hindwings there is more variation, and this extends between the full series—a large basal, two large central, and an outside transverse row parallel with hindmargin—to entire absence, except the three median and basal, of which the one on the discal cell is alone really prominent; in tint the spots vary from a deep warm orange to yellow. In the specimens of the American *mandan* in the British Museum collection, the spots are sometimes rather larger, but they vary just as greatly as in the European forms. The solitary example of *mesapano* is rather smaller and darker, and quite indistinguishable from some European examples in the collection. On the underside, the spots vary on the hindwings from yellow to quite white. The difficulty of grouping the aberrational forms is self-evident. With the material before us we do not see that we can do more than the following, based on the spotting of the upperside :—

1. The spots large, orange in colour (sometimes with tendency to coalesce), and inconspicuous interneural marginal series = ab. *aurantia*, n. ab.
2. The spots large, orange in colour, with conspicuous interneural marginal series = ab. *excessa*, n. ab.
3. The spots small and restricted (often fewer in number), orange in colour, marginal series obsolete = ab. *restricta*, n. ab.
4. As in 1, but yellow (not orange) in colour = *palaemon*, Pallas.
5. As in 2, ,, ,, ,, = *lutea-excessa*, n. ab.
6. As in 3, ,, ,, ,, = *lutea-restricta*, n. ab.

On the underside of the hindwings we have the following :—

1. The spots yellow, almost of the same tint as the ground colour = *palaemon*, Pallas.
2. The spots yellow, distinctly edged with darker = ab. *circumcincta*, n. ab.
3. The spots white = ab. *albiguttata*, Chris.

Stephens writes (*Illus.*, iv., p. 100) that "the colour and size of the spots vary greatly, and some specimens have the whole of the dusky-brown areas thickly irrorated with yellowish, both above and below; the sexes differ little in colour." Raynor observes that, in Lincolnshire, between 1892 and 1896, he captured—(1) a ♂ in which the two central orange spots on the hindwing coalesce, forming an irregular oblong; (2) a ♂ having all the paler markings of a dead dull orange, giving the whole specimen a very cloudy appearance; and (3) a ♀ in which the orange spots on the forewings are much reduced in size, so that the forewings have quite a brown look." Oberthür notes that aberrations occur in which there is a tendency to confluence of the spots on the upper- and under-

sides of the wings, and others in which the spots are much restricted or decreased; he has never seen any marked aberrations. The yellow tint of the wings also varies, being sometimes paler, at other times darker. Lowe notes the occurrence of a very dark and dingy form in the Val Anzasca. Frey notes that he took two ♂s at the end of July, 1865, on the Maloja, smaller than the type, more robust, rather short and roundwinged; on the upperside of the hindwings the three typical yellow central spots are present, but the outer row fails, differing thus from examples from the Swiss plains and from north Germany. One of these specimens, now in the British Museum collection, is a very marked aberration as Frey describes. Esper describes and figures a remarkable aberration (*Schmett. Eur.*, ii., p. 14, pl. xcv., fig. 5) of obsolete form (=ab. *esperi*). This is described in detail (*infrà*). The described Palæarctic forms are as follows:

α. ab. *esperi*, n. ab. *Paniscus* var., Esp., "Schmett. Eur.," ii., p. 14 (1796), pl. xcv., fig. 5 (1787).—A single ♂ from Gerning's collection. The divergence from the type is very considerable. Forewings blackish-brown, the long hairs yellowish, the spots on the underside are very varied, the large ones towards the apex of the wing are wanting, those in the middle almost entirely united with one another, this area having therefrom a whitish appearance. The hindwings on the upperside have a more yellow appearance, owing to the bright spots being placed near together in an imperfect band; the underside is also very like the upperside, but the colour is much paler, the yellow covers a larger area, and appears much finer; the ground colour is dark grey, and has, in the middle, a large circular spot; the outer margin has a row of semicircular dark yellow spots. The body is quite black. The rest of the characters as in the type (Esper).

β. var *albiguttata*, Chr., "Iris," vi., p. 87 (1893); Ruhl, "Pal. Gross-Schmett.," p. 635 (1895); Staud., "Cat.," 3rd ed., p. 91 (1901). *Brontides*, *in litt.*, Rühl, "Pal. Gross-Schmett.," p. 635 (1895).—Supra maculis minoribus flavis; subtus posticis obscurioribus, maculis albis. Vilui; Irkut; Ural merid., Güberli (Christoph).

Staudinger's note on this eastern form reads as follows: "Supra maculis flavis minoribus; subtus maculis albis. South Ural, Eastern Siberia, Kamtschatka, Amurland, Mongolia (Urga district)" (*Cat.*, 3rd ed., p. 91). Rühl says that the MS. name *brontides* is synonymous with *albiguttata*. Eversmann notes the examples taken in the Volga district, as having the spots above ochreous, and beneath white, edged with fuscous.

The Nearctic forms of this species that have been described are the following:—

α. var *mandan*, Edw., "Proc. Ent. Soc. Phil.," ii., p. 20, pl. v., fig. 1 (1863); Kirby, "Syn. Cat.," p. 624 (1871); Scudd., "Syst. Rev. Am. Butts.," p. 54 (1872); Edw., "Cat. Lep. Amer.," p. 49 (1877); Fern., "Butts. Maine," p. 95 (1884); French, "Butts. East. Un. Sta.," pp. 299-300 (1886); Mayn., "Butts. N. Engl.," p. 57 (1886); Fletcher, "Can. Ent.," xxii., p. 113 (1889); Scudd., "Butts. New. Engl.," ii., p. 1569, pl. x., fig. 2 (1889). *Paniscus*, Gosse, "Can. Nat.," p. 219 (1840); Streck., "Lep.," p. 69 (1874). *Palaemon*, Bean, "Can. Ent.," xxv., pp. 145-7 (1893).—Expands 1·1 in.; upperside brown, spotted with ochrey-yellow; primaries with a marginal series of small spots, with two of larger size submarginal; a straight transverse row on the disk of large angular spots, interrupted against the submarginal, two others in the cell, separated by a circular brown space. The secondaries have a small spot near the base, another on the inner margin, a large rounded one in the disk, and a submarginal series of small spots and points. Underside of primaries almost wholly ochrey-yellow, the spots corresponding with those above, but enlarged and confluent; secondaries pale reddish-brown with rounded spots of soiled white, corresponding, generally, with those above, but larger; the submarginal row is complete, and the margin is bordered by lunules; near the base is a second spot on the costa of equal size with the other. Lake Winnipeg, captured by Mr. R. W. Kennicott. This species is allied to *paniscus*

and *sylvius* of Europe (Edwards). Ovum.—Egg laid in confinement (♀s from Nepigon, in the Lake Superior district), on *Poa pratensis*. Pale greenish-white, hemispherical, broader than high, apparently smooth, under magnification very faintly and vertically grooved or wrinkled, and densely and uniformly pitted with deep pores, which are wide at the mouth and taper to a fine point (Fletcher); in their vertical parts, the wrinkles are about 0·06mm. apart; surface densely and uniformly punctate with very distinct, short, oval punctures, whose longer axis is vertical and about ·003mm. in length, arranged to a certain extent in short, irregular, sinuous series, giving a faint vermiculate effect. Diameter of egg, ·86mm.; approximate height, ·48mm.; punctæ about ·008mm. in diameter (Scudder). Eggs laid July 13th, hatched July 23rd. Larva.—*First instar* (newly-hatched): Length, 2·5mm.; breadth of head, 0·45mm.; of body, 0·35mm.; length of bristles, 0·05mm.; head large, smooth, black; thoracic shield narrow, black, bearing a few slender hairs; body yellowish-white, slender, of equal thickness throughout, bearing on each side four series of trumpet-shaped bristles. Duration of stage five days. *Second instar:* Length 3·5mm.; head white and furrowed at apex; thoracic shield black, much smaller than in first stage; body pale green, with two narrow white lines on each side, one subdorsal, the other supralateral; spiracles yellowish; whole body covered with a short pubescence. Duration of stage, five days. *Third instar:* Length 6·5mm.; head rather higher than broad, slightly broadest at the base; rounded at apex, bilobed by reason of a deep frontal groove; mandibles and two clouds on cheeks fuscous; thoracic shield transparent and hardly discernible; body pale green, translucent, the dorsal vessel and ramifications of tracheæ showing plainly through the transparent skin; on either side a pale subdorsal band with irregular edges, a distinct, clear, white supralateral stripe, and a very faint suprastigmatal line. The subdorsal bands unite on the anterior fold in the anal segment; the supralateral stripes at the end of the anal flap. Duration of stage, seven days. *Fourth instar:* Length 12·5mm.; head lighter in colour, without the fuscous marks on the cheeks, of the same width as the cylindrical body (Fletcher); head pale greenish in colour with a bluish tinge, obscured with very faint reddish-fuscous in a broad mottled stripe bordering the suture above the frontal triangle, and in a similar belt passing down the middle of each hemisphere, from the posterior point of the former, toward the ocelli, but fading out before reaching it; hairs white; ocelli black; mouth-parts pinkish at incisures and edges; body very pale yellow, nearly uniform; the dorsal shield of first thoracic segment of the colour of the head, with a median dusky line through it; last abdominal segment finely edged with fuscous and a little obscured above; an exceedingly faint, slender, greenish, dorsal stripe, and a slightly wider, but otherwise entirely similar, lateral stripe the whole length of the body; legs and prolegs concolorous; their claws, and the spiracle lips, pale testaceous; papillæ concolorous, hairs pale brown; length 8mm.; breadth of head, 1·25mm. (Scudder). Duration of stage, fifteen days (Fletcher). *Fifth (last) instar* (newly moulted): Length, 18·75mm.; head greenish, tinged with yellow; a little larger than prothorax and anal segment, but smaller than rest of body; squared at base; rounded at apex: deeply grooved down front; width at base, about equal to height; surface minutely roughened; ocelli black, arranged in semicircle, following contour of face, four in front and two on lower side, the third and fourth twice the size of the others; mandibles white with black tips; labrum black; prothoracic shield not distinguishable; body glaucous-green, with a pale subdorsal band, clearly defined with white above, much paler below, leaving a distinct green dorsal stripe; supralateral stripe conspicuous, creamy-white and clearly defined, not so wide as the pale subdorsal band; below this and halfway to the spiracles is a very pale, thread-like suprastigmatal line; spiracles white, very inconspicuous on a thread-like line (which may only be the tracheæ showing through the skin). On the meso- and metathorax, there appear to be beneath the transparent skin, instead of spiracles, knots of tracheæ. The whole body, including the head, minutely shagreened and covered with small piliferous papillæ, which on the pro-, meso- and metathorax are black at the base of the hairs. The subsegmental divisions are—the prothorax transversely grooved, the mesothorax three equal subsegments, the metathorax four small subsegments; abdominal segments 1-7 with five subsegments, the anterior twice the width of the second, which, again, is twice the width of the other three; the 8th abdominal, three equal subsegments; the 9th abdominal, two small folds; the 10th consisting of the anal flap. *Last instar* (at hybernating stage): The shape of the mature larva differs from that of the early instars, the body being largest in the middle and

tapering off to each end. The fullgrown larva measures 28mm. (twelve days after its moult into this instar); the furrow down the face deepened and appearing to open a little; hybernation commenced, and then the colour gradually changed, all the green fading out, and the body (in ten days) became of a yellowish-cream colour with white stripes. This again darkened until the ground colour was a very pale brown or dove-colour. In this larva, the lenticles appear to be saucer-shaped, having a raised edge; they are arranged in three lateral series, two of which are complete, and occur on all the segments except the head, and the other, ventral and incomplete, occurring only on abdominal segments 1, 2, and 7; the first series is placed above, and anterior to, the spiracles, and the disks are sometimes double upon the abdominal segments, but they are not always uniform on the opposite sides of the body. [In the specimen most carefully examined they were double on abdominal segments 4, 5, 6 and 7 upon one side, but only on 4 and 5 on the other, and on the 1st abdominal there was no disk of this series on one side, but it was present on the other; on the pro-, meso- and metathorax they are on the suprastigmatal line, on the 1st-8th abdominal segments, below the suprastigmatal line, and on the 9th abdominal, on the supralateral stripe, and larger than the others.] The second series is single throughout, posterior to the spiracles, except on the thoracic segments, where they are slightly anterior on the fold above the true legs. The third (ventral) series occurs only on the 1st, 2nd, and 7th abdominal segments just beneath the stigmatal fold (Fletcher). Legs with the claw and the apex of the penultimate joint black or blackish. Prolegs greatly infuscated, especially apically and upon the outside. Spiracles black, set in a small black field surrounded with a fusco-ferruginous areola. Length of the body 21mm., breadth of the same 2·8mm., of head 1·8mm. (Scudder). DISTRIBUTION.—Dominion of Canada: Anticosti, southern Labrador (Couper), Godbout, rare (Corneau), Lake Mistassini (Fletcher), Quebec (Bowles), Bevan's Lake (D'Urban), Compton (Gosse), Ottawa (Billings), Ontario—Bobcaygeon (Fletcher), Hudson Bay—Moose, common (Haydon *teste* Weir), Lake Superior—St. Joseph's Island, Sault St. Marie, common (Bethune), Nepigon, not uncommon (Fletcher), Lake Winnipeg (Edwards), Rocky mountains (Macoun), Lake La Hache (Crotch), Vancouver Island (Fletcher), Alaska (Edwards), Alberta—Calgary (Nicholl), British Columbia—Laggan, etc. (Bean), Keremeos, Penticton, Hedley, Illecillewaet Glacier (Nicholl), United States: California (Behrens), New York—? Adirondacks (Edwards *teste* Scudder), New England—not uncommon in the higher valleys of White Mountains (Scudder), at Norway (Smith), Maine (Fernald), Lake Chimo, near Bangor (Braun).

Bean, from examination of American specimens from Nepigon* (1 ♂), Laggan† (36 ♂s), and Banff‡ (1 ♂, 1 ♀), and European examples from Germany (4 ♂s, 2 ♀s), Zürich (2 ♂s, 1 ♀), and northern Finland (2 ♂s), concludes (*Can. Ent.*, xxv., pp. 145 *et seq.*) that *mandan* of New England, Eastern Canada and the Bow valley, and *palaemon* of Europe, are one species. His arguments are as follows:—

1. The European *palaemon* is so uniform in size and colour, and presents its variations in a manner so undemonstrative, that the true values of its variations are easily recognised, and it is readily seen that the several variational phases constitute but a single species..

2. *Mandan*, like many other American lepidoptera, is strongly influenced by the meteorological peculiarities of widely separated districts, inhabited by it in North America, and, in certain extreme conditions, displays its variational capacity with a freedom and exuberance quite in contrast with the conservative variation of the species in Europe.

3. The variation in *palaemon* is essentially as important as the more emergent and erratic variation shown in certain environments by *mandan*, and *palaemon* in its various attitudes is inseparable from corresponding aspects of *mandan*, and helps to render evident the unity of the extreme phases of *mandan*.

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* On the northern shore of Lake Superior.

† Laggan, elevation 5000ft., on the Canadian Pacific Railway, on the eastern slopes of the Rocky Mountains, the summit of Kicking Horse Pass being six miles only from Laggan.

‡ Banff, a few miles to the south of Kicking Horse Pass, still in the Laggan district.

I believe *mandan* contains but one species, although it has been so well supplied with synonyms, and its extremes of colour variation are so great.

4. Observation on the local larvæ of *mandan* shows that they agree with Frohawk's description of that of *palaemon;* the latter account also agreeing substantially with that of Fletcher (*Can. Ent.*, June, 1889).

Referring to the fact that the only point suggesting specific difference in *palaemon* and *mandan* had been the supposition that the former feeds on "plantain," and the knowledge that the latter feeds on "grasses," he points out that the rearing of the former on "grass" did away with this factor. As to the specimens compared, he notes that the Banff examples agree with the Laggan series; the Nepigon ♂ is almost a copy of one Finland ♂; it differs in having the median yellow-brown spots shorter (partly obliterate); on the underside the Finland example is more suffused with yellow, and the spots under the hindwings are less clear; otherwise in every essential character the insects are alike. The *mandan* of the Bow Valley (*i.e.*, Laggan) is closer to *palaemon* of Germany than to *mandan* of eastern North America. Arranging the series according to affinity of variation, the Nepigon example goes to one extreme, next follow the two Finland *palaemon*, then two of the *palaemon* from Germany, and a number of Bow Valley *mandan;* nearly all the remaining Bow Valley *mandan* range still further away by an increasing size and conspicuousness of the fulvous spots on the upperside of forewings (these spots being, in some specimens, so enlarged, as to replace almost entirely the dark brown of the general surface). The two *palaemon* ♂ s from Switzerland, two of the German *palaemon*, and a small section of the Bow Valley *mandan* ♂ s follow a line of variation somewhat diverse from what is seen in the major part of the series, but without special bearing on the main question, except as further illustrating the fact that *mandan* is more ready to break ranks. In one particular, all the North American examples are alike, the spots under the hindwings are clear in colour and distinctly in contrast with the ground colour. Part of the Europeans agree with the North American specimens in this, and the others have the spots suffused with dull yellow, as in *Cyclopides sylvius*. The description of *mandan*, in Fernald's *Butterflies of Maine*, indicates that the Maine *mandan* is practically like that of Nepigon, and that the spots on the underside of the hindwings are clear in colour, whilst the description in general covers *palaemon* equally with that of *mandan*. Edwards, in the description of *Steropes skada*, mentions that the spots on the underside of the hindwings, except the outer rows, were of a yellowish tint. Scudder describes the spots beneath the hindwing of *Hesperia mesapano* as very large and silvery-white, in the Laggan specimens the colour is a pale buff, scarcely white in any. The specimens of the Bow Valley are, on the whole, larger than those of Europe and eastern North America, and are more variable in size, ranging from the expanse of the Finland and Swiss examples, to a size noticeably exceeding that of the German specimens; they display also greater individual variation in the size and colour of the fulvous spots on the upperside of forewing (Bean). Skinner notes (*Can. Ent.*, xxv., p. 257) that, though the *palaemon* of middle Europe and the *mandan* of the White Mountains (of New Hampshire) look different enough, yet, when the series is completed by material found between the two extremes, there can no longer be a doubt as to their identity. He

further remarks that, in other species that occur throughout the Palæarctic and Nearctic areas, the specimens found in America on the Pacific side are far closer to the European examples than those individuals found on the Atlantic slope. The fact that *mandan* was identical with *palaemon* was pointed out by Moeschler (*Verh. der zool.-bot. Gesell. Wien*, xxxiv., p. 283). Couper states (*Can. Ent.*, November, 1872) that a specimen captured at Fox Bay, Anticosti, on June 26th, 1872, did not differ in the slightest from the European specimens; Jenner-Weir notes (*Entom.*) it at Moose Fort, on the south coast of Hudson Bay, much resembling *palaemon*, common in 1883, but not observed before.

β. var. *mesapano*, Scudd., "Proc. Bost. Soc. Nat. Hist.," xi., p. 383 (1868).—Resembles *H. mandan*, Edw. Wings above dark purplish-brown, variegated with dull orange spots, fringes dusky, blackish towards base. Primaries with a large irregular spot in the cell; it consists first of a square spot which occupies the whole width of the cell, and has its outer limit at the second divarication of the median nervule; starting from a little beyond the lower inner angle of the square spot, where it is divided by the median nervure, it does not reach the subcostal nervure, and is obliquely truncated or rounded; there is a subapical row of spots; the three subcostal ones are wedge-shaped, their apices pointed inwards; the two between the subcostal and median nervures are smaller than the rest, sublunate, and situated so much further outwards that their inner border runs parallel to the outer border of the other spots; of the spots below these, the first is triangular, the second is largest of all and subquadrate, the third and fourth are unequal and oppositely rhomboidal; midway between these and the base of the wing is a small roundish spot. Secondaries with two spots between the subcostal and median nervures, dividing equally the distance from the base to the tip of the wing, the inner ovate, scarcely half as large as the outer roundish one, a third small ovate spot at the first divarication of the median nervure, and sometimes a fourth small ovate spot between terminal divarications of the subcostal, sometimes a submarginal row of spots. Beneath dull fulvous, the primaries with brownish spots, the secondaries with very large silvery-white spots, encircled with yellowish-brown; the darker parts of the primaries are as follows:—the basal half of the wing, beneath the median nervure, fuscous; the basal two-thirds of the costal area obscured with fuscous; a dark spot occupying the upper half of the middle of the cell; a large oblong quadrate spot between the subcostal and median nervures, extending from just within the tip of the cell (where it encloses a yellow spot) more than halfway to the outer margin; above its basal third a slight infuscation; a quadrate spot between the first and second median nervules, its outer border reaching the second median nervule; a submarginal row of spots just without the row of yellow spots on the upper surface; those between the subcostal and median nervures sagittate. The spots on the secondaries are as follows:—a very large oblong oval one in the middle of the interspace between the subcostal nervure and its first nervule, two spots dividing equally the interspace, between the subcostal and median nervures, the inner oblong-oval, as large as the first-mentioned, the outer the largest on the wing, and subquadrate; the latter forms one of a straight discal row of spots, subparallel to the outer border, the others being as follows:—a spot similar to the first two mentioned, situated between the median and submedian nervures; a small roundish or ovate spot between the latter and the largest spot, and beyond the largest; a roundish or subtriangular spot, half as large as the first-mentioned spot, situated near the outer angle; above this, at right angles to the extremity of the straight row, a small roundish spot; a submarginal row of five small roundish spots, those between the subcostal and median nervures small and marginal, sometimes obsolete. Expanse of wings one inch. Taken at Norway, Maine, June 13th, by Mr. Smith.

It will be observed that the marked character of this form, "the underside of the hindwings with very large silvery-white spots, encircled with yellowish-brown," brings it into line with var. *albiguttata*, Christ. (*suprà*).

γ. var. *skada*, "Trans. Am. Ent. Soc.," iii., pp. 196, 214 (1871).—♂ expands 1·05 in. Upperside dark brown, nearly black, spotted with ochraceous; primaries have minute submarginal spots opposite the cell; a median row of large size, long, and

mostly angular, extending quite across the wing, excepting against the two submarginal spots; a large rectangular spot at outer end of cell, beneath the lower inner angle of which is a small triangular spot; along the hind margin faint traces of points or spots, scarcely more than a few scales, excepting at apex, where are two small clusters of scales. Secondaries have a submarginal series of points, a large subrectangular spot on middle of disk; against this, towards abdominal margin, a small oval spot; another oval of rather smaller size in middle of cell; fringes pale brown. Underside of primaries ochraceous from base to outer edge of median row of spots, which are enlarged, confluent; within this ochrey space is a small oval black spot in cell, another near origin of first median nervule, and a large rectangular black spot beneath the last in submedian interspace; the interval in ochraceous median row black, as is also the space between that row and the marginal spots, which are distinct; the two submarginal spots as on upperside. Secondaries of a darker or brownish shade; the marginal and submarginal rows complete, the spots being small, of nearly equal size and mostly subrectangular; the discal spots repeated, slightly enlarged, with black edges, and, in addition, a similar oval spot on abdominal margin against the first oval named; and another, larger, on costa against the cellular spot; all these spots of a paler shade than the ground colour, whereas the marginal rows are concolored on a darker ground. Received from Mr. James Behrens, and taken at Kodiak by Mr. Bischoff. This species is allied to *mandan*, Edwards.

Edwards seems to have described (*Trans. Amer. Ent. Soc.*, iii., pp. 196 and 214) the species twice over from the same specimens in the same publication. There may have been some special reason for this, but we do not follow that this is so, and simply mention the fact that students may refer thereto if necessary.

Egglaying.—In confinement, eggs were laid singly, and attached firmly to the blades of *Bromus asper* on June 14th, 1891, and commenced to hatch on June 24th (Frohawk). Two eggs laid on the same blade of grass May 26th, 1893 (Raynor). Buckler had eggs that hatched on June 11th, 1883. Bean notes (*Can. Ent.*, xxv., p. 148) that he had several eggs laid one night by lamp-light at 11 p.m. The young larva, he says, emerges near the apex of the egg, and usually eats little, if any more, of the shell, than is sufficient to allow of its exit. Eggs laid July 13th, 1888, on grass, at Nepigon, hatched July 23rd (Edwards).

Egg.—Of a very pale straw colour, comparatively smooth, with scarcely any marblings or marks. It is, in shape, rather more than hemispherical with flattened base. A number of irregular, very fine flutings run in a general way from base to apex, the spaces between looking, under a high power, as if irregularly pitted. The micropyle is remarkably characteristic; it is placed right at the apex in a small hollowed basin, rising into a rounded elevation in the centre of the depression, almost like an inverted cup in a saucer, except that the central elevation does not reach up to the rim of the depression (Tutt, May 26th, 1893). Ten days later the apex of the egg was very dark, and the following day (June 6th) a very dark round spot was seen occupying exactly the apex of the egg; under a powerful lens this was shown to be the head of the larva, the brown mouth-parts, as well as the blackish head, being exceptionally conspicuous (Tutt, June 6th, 1893). In shape, hemispherical with flat base, its colour white and shining like porcelain. Three days before hatching, a dark spot appears near the top, becoming, the next day, a large, dingy-greyish blotch, which sullied the entire surface as the shell became more transparent. The spot becomes defined as the head of the larva the day before hatching (Buckler). The egg is ·8mm. wide, being about one-fifth wider than high, of a somewhat compressed conical form,

bulging a little below the middle, and becoming less in size on nearing the base, which is rounded at the edge; the base itself is slightly concave; the crown is rounded; the operculum is small and rather sunken and very finely punctured; the entire surface is smooth, showing only faint granulations and mere indications of striations on the lower half, running from the middle to almost the base. It has a pearly appearance, being whitish or yellowish-white in colour with opaline reflections; shortly before hatching the colouring becomes opaque, and a dark leaden spot appears at the crown, caused by the dark head of the larva showing through the shell. In ten days after the egg is deposited the young larva emerges by eating away the crown (Frohawk. June 24th, 1891).

Habits of larva.—The young larva emerges by eating away the crown of the egg and the sides until very little remains. Soon after emergence it commences making for itself a little tubular dwelling, drawing together the edges of the grass-blade by spinning about three or four stout cords of silk, each cord composed of a great number of strands, which quickly contract, causing the edges to come together and sometimes to overlap, forming a compact short tube; the making of one of these tubes occupies about four hours; generally, before spinning, it nibbles off the extreme edge of the blade to which the silk is afterwards attached. It feeds upon the blade both above and below its abode, eating quite through the edge, devouring so much that frequently only the midrib of the blade remains, and the tube is only just long enough to conceal it; it then shifts its quarters and prepares a new home. As the larvæ get older, these tubular residences become more conspicuous. The larva is particularly active when disturbed, and, upon the slightest touch, it rapidly runs out of its tube, either backwards or forwards, and, after remaining quite still for a time (sometimes as long as an hour), until all apparent danger has passed, it retreats into its abode. Its natural movements, however, are very slow, especially directly after a moult or when seeking a fresh spot to make a new tube, and it appears to show no disposition to wander away from the part of the leaf which it is eating. For moulting, the tips of the leaves are usually drawn together so as to form little cylindrical retreats securely fastened by spinnings of silk. From mid-August to early September the larvæ devour their cases very quickly, first eating the lower part of the leaf all but the midrib, then devouring the top of the leaf above the tubular part, and, lastly, the tube itself, until it becomes too short to hide the larva, when it is deserted and a fresh leaf selected. When nearly fullfed they make very imperfect tubes and are content to lie along the underside of a leaf, the top of which they soon devour. When fullfed in October the larva draws a leaf round itself as it rests on the underside of the leaf; if not wide enough, the space between the edges is well filled up with whitish silk, forming thus a complete cylindrical silk-lined hybernaculum, or it may spin two blades of grass together at their edges thus forming a closed tube. In this, they remain absolutely quiescent from mid-October to March. The larva under observation moved to the end of its hybernaculum on March 12th, remained there till the 21st, when it quitted its abode, lying quietly for some days of low temperature until April 1st, which, being warm and bright, caused it to move restlessly, when it began its puparium. It pupated on April 8th.

Altogether it was 289 days in the larval state, and of these was fixed for pupation five days before changing. The larva has the power of casting its excrement sideways with considerable force, sending it a foot or more, undoubtedly in order to prevent it fouling its domicile. Fletcher, describing the form *mandan*, says (*Can. Ent.*, xxi., p. 113), that, in confinement, from the hatching-time, the larvæ were great wanderers, frequently leaving their foodplant, and crawling all over the glass—used as a cage; in these wanderings they spun silken paths wherever they went. . . . . The habit was kept up through all the stages, . . . . and, at no time, did they construct a tent by catching several leaves together in the manner of the larvæ of *Pamphila mystic*, *P. cernes*, and *P. manitoba*. Directly after hatching, the young larvæ climbed to the tops of the blades of grass and made a sort of tent by catching the opposite edges together with two or three cords of silk, about $\frac{1}{2}$ in. below the tip; they then attacked the edges of the leaf, eating down each side and leaving the midrib. When at rest, during the first three stages, they retired beneath their tents and lay extended along the midrib. Their habit of choosing wide-leaved species of grass for food, the shape of their bodies and coloration, added to a habit of lying extended down the midrib with the body closely appressed, the lower part of the head protruded, and the apex drawn back, caused these larvæ to be well hidden from observation; after the third moult they would sometimes roll the leaf of a wide species of grass, as *Panicum crusgalli*, into a tube similar to those made by *Pamphila hobomok;* after the fourth moult no tent was made, the larvæ lying exposed on the upper surface of the leaves when at rest. After attaining its full length (September 12th) it fed sparingly for about two weeks, and then spun a mat of silk on the face of a blade of grass and drew two other blades over it with single strands of silk; it ceased to eat, its colour changed, and it evidently meant to hybernate for the winter (unfortunately in the middle of November it was attacked by mould and died).

Ontogeny of larva.—*First instar* (June 24th, 1891): When newly-hatched, 2mm. long; the head large, intensely black and shining; the body cylindrical, of a creamy-white colour, including the legs and claspers, and of a rough or velvety texture; on the prothorax, encircling the upper half, is a black linear or crescentic collar; there are six longitudinal series of short, fine bristles, three on either side. After feeding two days, the body changes to a faint bluish-green tint. The first moult occurred on July 8th. *Second instar* (July 9th): About 6mm. long; the body, cylindrical and slender, without markings; the segments well-defined, and transversely wrinkled; clothed with very short and fine hairs, most minute, giving the surface a velvety appearance; the colour is of a very pale yellowish-green, in certain lights appearing of a whitish-green; the head is large, elongated, flattened above, black and shining, as also is the prothoracic collar. Second moult, July 17th. *Third instar:* 12mm. long; colour, very pale green, with a fine longitudinal mediodorsal line, a darker green, and a subdorsal green line, slightly darker than the ground colour; each line is bordered by a paler stripe; the head is black, mottled with pale brownish-grey on the centre of each lobe, and a blotch above the mouth; there are five glistening black warts, set on a glazed collar of pale green, encircling the upper half of

the prothorax; the central wart is largest; on the anal segment is an elongated oval black mark, narrowed in the centre. On July 24th, being 30 days old, and still in this instar, it was 12·5mm. long, 2·5mm. in diameter, and perfectly cylindrical throughout. Third moult, on July 30th. *Fourth instar* (August 6th): 17·5mm. long; the body of the same shape as in previous stage; colour, pale whitish-green; a longitudinal mediodorsal line, rather dark green, bordered on each side by an almost white, very fine, line, followed by alternate darker and lighter lines, the lightest being extremely fine; then a subdorsal darker green line, bordered laterally by a conspicuous whitish line, which is again bordered below by a paler and indistinct green line, and a very faint spiracular whitish stripe, on which the spiracles are placed; they are white, outlined by a dark, but indistinct, ring; the undersurface is whitish-green; the head is about the same width as the body, rather depressed, and of a pale greenish-grey colour, with black markings, one central between the lobes, and one down the middle of each lobe, the central one bifurcating and uniting the others in front; the eyespots are black; both head and body are clothed with very short stiff hairs; the anal segment is elongated, porrected and flattened, overlapping the hind claspers; the central black marking, previously mentioned, is, in this stage, very conspicuous; the legs are dark grey, with whitish extremities; the claspers of the same colour as the undersurface; the segments are transversely wrinkled. The fourth and last moult took place on August 17th. *Fifth instar* (August 18th): Colour of a clear, pale whitish-green; at each segmental division the skin is loosely wrinkled, each fold or wrinkle being pale yellowish-white, especially noticeable between the first six or seven segments; the remainder are fairly uniform in colour; each segment is delicately wrinkled transversely, in addition to the divisional folds mentioned. With this moult, a great and important change takes place, *i.e.*, in the colouring of the head, and the disappearance of the oval black blotch on the anal segment (so conspicuous in the former stage), the black warts, and the prothoracic collar. The head is now entirely of a pale whitish-green, with a faint bluish tinge, excepting an extremely fine central black line, separating the lobes of the crown, and there are six tiny black ocelli; five in the form of a crescent, and the two lowest are the most conspicuous and bead-like. On each segment are a few exceedingly small black specks, only just visible by the aid of a strong lens; the most distinct are those forming a double longitudinal dorsal series, two in the middle of each segment; these appear concave, and very metallic, reflecting a high light; the markings appear precisely similar to those in the previous stage. The legs, claspers and undersurface are uniformly pale green in colour; below the spiracles, the body is dilated, making the undersurface flat and rather concave. The head is large, fully 2mm. in length, and broad in proportion; it is porrected, and slightly compressed on the crown; the body is about the same width as the head, and of equal thickness throughout; the anal flap is of the same form as before moulting; both the head and body are clothed with short fine hair; the surface of the head finely granulated. *Later* (September 12th): Considerably increased in length, 23·5mm.; the colour changed to a clear yellowish-green, but still pale; in other respects it is the same as described. *Later* (October 3rd): Now 101

days old; length still 23·5mm., but more robust; the ground colour changed to a very pale primrose-yellow, the stripes of a slightly darker hue, the white lateral line showing clearly, the spiracles brownish; the head, pale buff with a faint lilac tinge, a black patch above the mouth, and brownish at the sides, the black ocelli and central line showing as before. *Later* (February 9th, 1892, during hybernation): The colour had now changed to pearl-grey, and it had a semitransparent appearance, the dorsal lines drab, and clearly pronounced. *Later* (March 21st): Contracted to 18·75mm.; the colour of a delicate cream or very pale primrose, inclining to pinkish; the lines of a pinky-drab, and very clearly defined, the subdorsal lines separated by an almost pure white stripe; the head remained unaltered in colour (Frohawk).

Larva.—*Penultimate instar* (?): 19mm. long. A front view of the head shows it to be very square rather than round, *i.e.*, two sides, top and bottom, flattened. The subsegmentation is noted as follows:—prothorax undivided, mesothorax and metathorax each with three subsegments, the abdominal segments 1 to 7 with five subsegments, the front one being rather larger than the remainder; the 8th abdominal has three subsegments (but the divisions are obscure and there may be five), the 9th and 10th are undivided, the 10th projects a long way behind the claspers, looking much like a Satyrid larva, except that the projection is of the whole segment and not of two anal tails. The abdominal spiracles are on the 2nd subsegment, *i.e.*, the first of the four smaller ones, although at the spiracular level this subsegment widens out, encroaching on others, and spreads into the lateral flange a little below the spiracle. The spiracle of the 7th abdominal, and more markedly that of the 8th, is placed very dorsally. The dorsal tubercles are not determinable, but below the spiracle is a minute brown ring (lenticle). There is a broad subdorsal whitish band, a narrower, more defined, one below this, and a less distinct one lower; in front, this is some distance above spiracles, but posteriorly, where they are placed higher, they are close up to it. The prolegs have complete circles (ovals) of crochets almost entirely in one row, but with a smaller one or two interiorly; there is some little deficiency in the hooks on the outer margin. The larva possesses an "anal comb," essentially no doubt the same appendage as that described by Hofmann (*Ent. Annual*, 1873, p. 61) (Chapman. September 5th, 1893).

Foodplants.—*Brachypodium sylvaticum* (Disqué), *Bromus asper* (Frohawk), *Cynosurus cristatus* (Curtis). The larvæ feed freely (in America) on all grasses offered to them, but seemed to prefer the wide-leaved species—*Panicus crusgalli*, *P. sanguinale*, and *Triticum repens* (Fletcher). [*Plantago major* (Duponchel, Stephens, etc.) is erroneous. In 1832, Duponchel (*Iconographie*, p. 215, pl. xxxi., fig. 91) notes this as the foodplant of *palaemon*, and figures the larva thereon. Fletcher (*Can. Ent.*, xxi., p. 113) put young larvæ on this plant, but they refused to eat it.]

Puparium.—The fullfed larva spins the tops of the grass blades together, forming a tent-like structure, and, along the surface of one of the broadest blades, a little carpet of silk was spun, upon which it rested with its head uppermost; a silk cord also encircled its body round the 4th segment. It remained fixed for pupation at least five

days, after which it cast its larval skin quickly, being at one time free at the anal end, and supported only by the silken belt, the cremastral hooks, however, being fastened into the silken pad in about 20 minutes; the pupa assumes its final form and colour in about three hours after pupation, altering very little in hue from the last coloration of the larva (Frohawk). Some larvæ, reared in 1883, were fullfed in October, when they drew a grass blade round them, forming of it a complete cylindrical silk-lined habitation. In this they remained till the following February, when their removal caused the larvæ to leave the caves, and do a little spinning on the gauze covering of, or under the top edge of, a cylinder in which they were placed. In these webs they fastened themselves to an anal pad and spun a silken belt round the middle, becoming pupæ during the second and third weeks of March. As the larvæ ate nothing in spring, their hybernacula should possibly have been their puparia (Hellins). On March 19th, 1894, a larva that had been hybernating since the previous October, began to move, and left its hybernaculum as soon as brought into a warm room, it would not eat, however, and remained white and colourless. It did some spinning, but, being disturbed, finally spun up on the glass in which it was confined. With a general slight web over the whole area, there was no definite extra anal pad, but, on either side of the thorax, were two special mutton-chop-shaped pads, from the inner angles of which the girth sprung. The girth at first crossed over the metathorax, but later it was found crossing the prothorax; how the change occurred was not observed* (Chapman).

Pupa.—The pupa has a very deep groove between the metathorax and the 1st abdominal segment, made by (or for) the girth (which is not now in it). The 7th abdominal segment is fixed; no maxillary palpi are present; points of third pair of legs show beside tips of maxillæ; second pair of legs extend beyond antennæ; the cremaster forms a bundle of very fine hooks on long shafts, terminal and slightly ventral (Chapman. Note made from living pupa, March 21st, 1894). Length 15mm. Transverse diameter, across eyes (*i.e.*, 1·5mm. from front), 2·3mm.; at the wing-spines (*i.e.*, 4mm. from front) 3mm.; thence it regularly tapers to 2·5mm. at 6th abdominal segment (12mm. from front†), thence it tapers more rapidly but regularly to the end of the cremastral spine, which is somewhat sharp. The nose-spine in front is about 0·6mm. across base, and 0·8mm. long, fairly conical and sharp-pointed, but sloping out at its base to the general surface laterally; dorsally, its surface is in a straight line with the mediodorsal line; ventrally, this surface turns sharply ventrad, forming, beneath the horn, a small surface directed to the front. Viewed laterally, the dorsum is straight from the middle of the mesothorax to the 5th abdominal segment; in front of this it slopes ventrally at an angle of about 30°; behind the 6th abdominal segment it continues to the cremaster in a curve. The head is 1·5mm. in front of, and apex of cremaster 1·3mm. behind, the main dorsal line (if continued). Ventrally, there is a nearly straight line the whole length of the

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*For pupation, the larva suspended itself exactly like a *Papilio*, except that the girth was loose instead of being fixed by sinking into the chitin of the dorsum (Chapman. June, 1894).

† The free segments are a little telescoped, thus abbreviating some dimensions.

maxillæ, in front of this is the hollow below nose-horn, whilst behind, the line curves to the base of cremastral spine, which is hollow ventrally (pen-shaped). The antero-posterior diameters would be: the head (1·3mm. from front), 1·5mm.; at summit of mesothorax and wing-spines (4mm. from front), 2·8mm. tapering to 2·2mm. at posterior margin of 6th abdominal segment (12mm. from front). The texture is semi-transparent with darker markings, the colour during life would, therefore, be very pale ochreous. The markings are a black dorsal line from prothorax to end of cremastral spine; this just reaches to the head; a subdorsal black line faint on head, at back of eyes, on mesothorax down patagia, and apparently in line with broad black line down inner margin of forewings. Ventrally, the base of maxilla and of 1st legs have a good deal of black, the posterior three-fourths of the maxillæ making a notable black line down the venter. The wing-veins are clearly marked out by lines that are something short of black. They are the 1st and 2nd anal veins, the cubital continuing straight into vein 4 (median 3), the median (fainter than the cubital) meeting the transverse veins between 5 and 6 (median 1 and 2); the radial is only seen just where it joins the transverse, and gives off veins 7, 8, and 9; the rest of the radial, as well as the subcostal and veins 10 and 11, is wanting. These veins reach to "Poulton's line," beyond which is a spread-out colourless margin, almost 1·0mm. wide at apex, barely 0·2mm. at anal angle; the wing-apex is just within posterior margin of the 4th abdominal segment. The maxillæ are free only as to their extreme tips, which reach over on to the 5th abdominal, supported by tips of 3rd legs, which reach halfway from end of wings to end of maxillæ. The hindwings are a narrow colourless strip, wide opposite the 1st abdominal, notched from the spiracle of the 2nd abdominal, and disappearing under 1st wing just after reaching the 3rd abdominal. The spiracle of the 2nd abdominal segment is barely free, whilst that of the 3rd abdominal is covered by wing (this may be normal for the species or only an accident in this specimen). The glazed eyes face forwards, and, on dehiscence, each separates in one piece, with the included area behind. The labrum is narrow and long, and the lappets on either side (mandibles ?) are well-marked; there is a narrow scrap (labium) between the bases of the maxillæ. The maxillæ reach well forward, so that the labrum is rather anterior than ventral. The antennæ reach down to about the middle of the 3rd abdominal segment (about as far as hindwings), the 3rd legs a little beyond (nearly to hind margin of the 3rd abdominal); the 1st legs are considerably shorter; the 2nd legs abut widely against eyes. On dehiscence, the headpieces separate from antennæ, etc. The dorsal headpiece is about ·6mm. across (on either side), 0·14mm. wide at dorsal, and 0·2mm. at outer, end; it remains attached to prothorax, and, with the 1st and 2nd segments of the thorax, splits dorsally on dehiscence. The metathorax does not split, but separates from the mesothorax, and the 1st and 2nd wings separate for some distance. There is a wide hiatus between the metathorax and the 1st abdominal segment, which was obviously present during life, the bottom of the gap being transparent membrane; this looks as if it were an accident in this specimen, though the membrane below shows that it is probably, if so, not a rare one. A depressed line on the wings shows that the girth passed across middle

of metathorax, which is a very narrow segment. The length of the segments dorsally are about as follows: Dorsal part of head 0·2mm., prothorax 0·6mm., mesothorax 2·4mm., metathorax 0·4mm., 1st abdominal 0·8mm., 2nd abdominal 1·0mm., 3rd abdominal 1·3mm., thereafter getting narrower again. The general surface has a sculpturing of minute transverse waved ridges, anastomosing freely, and scattered over it are a good many very minute (microscopic) hairs, apparently colourless, their length 0·03mm.-0·04mm.; these also occur in the inner eye area, but not on the appendages, which have similar sculpture, but the waves tend more to an arborescent character, as well as being more and less pronounced on consecutive areas. The anal scar is very marked, two large bosses facing posteriorly, being below the hollow of the cremastral spine. On the 9th abdominal are two small rounded elevations, with incision between—the specimen is a female, but the posterior margin of the 8th abdominal is hardly notched, and the foveola on the 8th abdominal is small and close to posterior margin, and so inconspicuous that the specimen was, I see by my notes, supposed, before imago emerged, to have been a male. The cremastral hooks very numerous, crowded together, at the lower angle of end of spine. Each is nearly 0·25mm. long, with a curl of a complete circle at its tip (Chapman. Description made from the empty pupa-case of the pupa noted above as having been examined alive, March 21st, 1894). The pupa is 15mm. in length, fairly cylindrical, but tapering to anal segment. *Dorsal view:* The head, pointed in front, in the form of a short conical beak, 1mm. long. The eyes are rather prominent; the thorax is swollen in the middle, the widest part, and then gradually tapers towards the last segment, which is elongated and flattened; the back of the abdomen almost hollow, curving up again at tail. The anal end rounded, but continued as a flat cremastral spike, set at the tip with a dozen or more curled spines of different lengths. The colour on the back creamy-white, with a very dark brown thin central line from the head-spike nearly to the tail, a subdorsal line of pale buff bordered with reddish-brown, and then a shorter buff line edged below again with reddish-brown ; the wing-cases and ventral surface pale flesh-colour, faintly tinged with dusky, the straight tongue-case dark brown. *Lateral view:* The beak is slightly upturned, the thorax convexed, and the segment next the thorax rather swollen in the middle, so forming a rather decided depression at the base of the thorax, where the silken cord passes round; the body gradually tapering to the last segment, which terminates in a long compressed curved process furnished with long hooks; the wing-cases extend down two-thirds its length, and are only very little, if at all, swollen; the antennæ and legs are but feebly modelled; the tongue is well-defined, dusky at the base, blending into black at the apex; the colour is of a very pale primrose-yellow, shading into pearly-grey, and semi-transparent on the head, wings and flap; a dark mediodorsal line commences at the base of the beak and passes down the entire length, gradually fading off in the anal extremity; it is blackest on the head and first abdominal segment, and palest on the thorax, where it is light brown; there are two rust-red subdorsal lines, which run parallel from the base of the antennæ to the last segment; another similar line, united along the inner margin of the wing, passes over two spiracles, and these run parallel with the subdorsal lines, passing just above the

remaining five spiracles, which are indicated by brownish specks; at the base of the antennæ are two short and fine blackish streaks; the antennæ and wings faintly outlined with dusky brown. In general appearance and colouring, the pupa closely resembles a piece of dead withered grass. Five weeks later the pupa begins to change colour, the wings turning greyish, and the eyes a deep pinkish-purple, and finally becomes a dull leaden-grey all over. A ♀ emerged five days later (May 20th, 1892) (Frohawk).

Time of appearance.—This is everywhere in the Palæarctic region a single-brooded species, usually occurring for only two or three weeks in late May or early June each year in England, France, and the lower parts of central Europe, but varying somewhat according to the season. In the mountains, however, the end of June and July are its more normal time of appearance, and even early August has been occasionally noted. Slater remarks that his observations, spread over some 14 years, in the woods of Northamptonshire, suggest May 10th-June 5th, as the usual time of appearance, varying, however, with the season, specimens being on the wing, in 1893, as early as April 21st. In the Nearctic region, the species also emerges from the pupal stage earlier or later, according to the forwardness or tardiness of the season, and is by no means so prompt to a date as are some of the local butterflies. There is no indication of more than one brood in a season. At Laggan (Rocky Mountains of Alberta) the species emerges in June, the ♂s in ordinary seasons appearing early in the month; the ♀s during the last half of the month; several ♀s have been taken at Emerald Lake (5600 feet elevation) in early July, and a ♀ at Agnes Lake (6800 feet elevation) early in August (Bean). Throughout British Columbia, and the valleys along the United States' boundary, it appears in June and July, and was noted as occurring at Calgary, Alberta, at about 3000ft. elevation, on June 24th, 1904; in British Columbia, at Keremeos, 4000ft., on June 15th, 1904; at Penticton, at 2000ft., on June 13th; at Hedley, at 4000ft., on June 10th; and by the Illecillewaet Glacier, 6000ft., on July 11th, 1904 (Nicholl); suggesting that its time of appearance is largely modified by altitude, as in Europe. It is also noted as occurring on June 26th, 1872, at Fox Bay, Anticosti (Couper); in the White Mountains, it appears from June 5th to middle of month; at Nepigon, in good condition, early in July (Scudder). The most remarkable record is August 10th-24th, when butterflies were taken at Sault St. Marie; Scudder thinks that this indicates here a possible second brood, but remarks that it is no further south than the White Mountains, where it is never seen later than June. In Europe, Miss Fountaine observes that it flies in the Rohrwald, near Vienna, and in the Szaar Forest, at the end of May, but on the top of the Maloja Pass, in the Engadine, at the end of June. In the Lower Volga district, Eversmann notes it as occurring in May and early June, and Caradja, May and June in Roumania. In Scandinavia, a single ♂ was found at Oplorig, near Kolverid, at 65° N. latitude in the beginning of July, 1875 (Collett). In Savoy, near Geneva, at the foot of the Grand Salève, the average time of appearance is from May 8th to June 5th (Blachier). In Belgium it occurs from May to July, according to the season (Lambillion). Duponchel says that it usually begins to appear in the forest of Raismes, near Valenciennes, about May 10th, in one year as early as May 6th, whilst Oberthür notes that the species is very common at the end of May and beginning of June in the Forest of

Rennes; whilst Griffith's statement that it is double-brooded at Morbihan, occurring in May and again in July-August, is almost certainly erroneous. The following dates may prove interesting. Continental records: From May 5th to July 15th, in different years at Brenne (Martin); April 23rd to May 25th, in different years, near Innsbruck (Fritsch); May 4th, 1860, and July 23rd, 1864, on the Zürichberg; May 21st, 1864, in Höcker-on-the-Albis; May 14th, 1865, near Wallisellen (Dietrich); end of July, 1865, on the Maloja (Frey); May 25th, 1878, near Senftenberg (Fritsch); August 3rd, 1880, quite fresh at Nassfeld (Hormuzaki); May 17th, 1888, on the Axenstrasse (Hutchinson); June 16th, 1890, at Les Plans (Fison); May 29th, 1891, at Hermance; May 31st, 1891, at Onex (Blachier); June, 1892, at Certosa di Pesio (Norris); July 1st-6th, 1892, at Chamonix (Oberthür); last week in June, 1895, on the Maloja (Fountaine); mid-July, 1895, at Pejo (Lemann); June 1st, 1897, at Sépey (Lowe); last week in June, 1897, just above Sépey; May and early June, 1898, and April 28th, 1899, at Veytaux, (Wheeler); end of June, 1898, in the Bernese Oberland (Oberthür); June 2nd, 1899, males all going over, but females still fine at Rennes (Oberthür); June 20th, 1899, in the Turtmannthal (Buckmaster); June 26th, 1899, in the Rilska Valley (Nicholl); June 11th, 1900, in the Val Strona; June 12th, 1900, in the Val Anzasca; July 2nd, 1901, at Innsbruck; July 10th, 1901, at Trafoi; July, 1901, at Engelberg (Lowe); June 27th, 1901, in the Fluelathal; June 28th, 1901, in the Dischmathal; June 30th, 1901, at Flims (Fison); June 6th, 1902, at Freiburg-in-Baden, common; end of June, 1902, at Susa; June 26th, 1902, at Pesio (Lowe); June 26th, 1902, one specimen at Aigle (Sheldon); May 4th, 1903, at Chantilly (Oberthür); May 30th, 1903, at Vionnaz (Wheeler); June 23rd-24th, 1903, between Göschenen and Wassen (Keynes); June 17th, 1904, at Macolin (Lowe); July 10th, 1904, in the Juras, at 1200m.; very abundant in the Bois des Frères, near Geneva, from May 5th-June 26th (worn), 1905; the Grand Salève, May 20th, 1905; Vuache, at 800m., May 24th, 1905; at Gaillard, May 26th, 1905; in the Grande Gorge, on Mont Salève, June 4th, 1905 (Muschamp); June 20th, 1905, at Loèche (Pearson); June 21st, 1905, at Villars (Lowe); May 28th, 1905, at Versoix; June 21st, 1905, at Martigny (Blachier); June 27th, 1905, in the Oythal, in the Allgäu district (Dadd). British records:—In Lincolnshire, it continues on the wing till about June 20th, when it is much wasted (Raynor); May 1st, 1823, June 6th, 1826, at Milton (Henderson); June 20th, 1854, at Craycombe (*Trans. Worc. Nat. Club*); plentiful May and June, 1872, 1873, and 1874, at Barnwell Wold (Conquest); June 2nd, 1881, not common, near Lincoln; June 2nd, 1882, near Lincoln (Fowler); June 3rd, 1882, at Barnwell Wold (Fraser); June 1st, 1891, at Lincoln (Mackonochie); June 2nd, 1891, fresh at Wansford, a late season (Vipan); earliest dates for the following years are May 26th, 1892, at Langworth, near Wragby; May 4th, 1893, at Langworth; May 25th, 1894, at Legsby; May 27th, 1895, at Langworth; May 27th, 1896, at Legsby (Raynor); one bred June 6th, 1894, from an egg sent from Lincoln (Chapman); May 19th, 1897, plentiful near Wansford (Sheldon); two captured June 1900, at Pond's Gate, Dartmoor (Walker); June 15th, 1900, in poor condition, near Uppingham (Kaye); May 31st, 1905, in Bedford Purlieus, near Wansford (Newman); end of

May and first week of June, 1905, a few ♀s remaining on the wing later, in the woods of Northampton and Rutland (Rothschild).

Habits.—In its first known British locality, Clapham Park Wood, in Bedfordshire, Abbot noted it as "occurring in May and June, flying freely in the morning, from 7 a.m. to 9 a.m., very often playing in pairs just after sunrise, or as soon as the morning fog has evaporated, its flight being extremely short and very near the ground; it delights to settle on the blades of very long grasses, or *Carices*, and is far from being a timid insect." This is strange, for Raynor writes that, in his experience, the species begins to fly about 10 a.m., never, so far as he has observed, earlier, although he has been in its haunts by 9.30 a.m. The Lincolnshire woods, where he knew the insect for five years, situated about halfway between Lincoln and Wragby, constitute a considerable range of apparently primeval woodland, and are very similar in character to Monk's Wood, in Huntingdonshire, and other well-known large woods in the midlands. Through these woods are cut, in several parts, rough roads, some twenty feet in breadth. These are covered with herbage and various wild flowers, forming a favourite resort for butterflies. Here, towards the end of May, and on till about the third week in June, this species may be found in varying quantities, according to the season. It is a most beautiful object as it flashes along like a living jewel, taking short flights from one flower to another, generally selecting the blue bugle, but occasionally the wild forget-me-not. Towards midday its flights are longer and more rapid, and, when chased, it occasionally deserts the ridings altogether, and either settles on the leaves of a bush some ten or twelve feet from the ground, or disappears altogether over the top of the wood. It may be seen flying as late as 5 o'clock in the afternoon, after which time it is frequently found at rest, either singly or in pairs, on long grass blades, and occasionally on *Ajuga reptans*. When settled and engaged in sucking nectar from the flowers during sunshine, it closes its wings over its back, but when merely resting, opens them at intervals when the sun shines. Pairing takes place in the early afternoon (Raynor). Muschamp says that "the flight of this species is more rapid than that of its near relations, but it never appears to rise to fly, skimming along, almost touching the ground; it flies pretty well straight ahead, in somewhat un-skipper-like fashion;" yet Scudder says that "it is a feeble flier for a Hesperian, keeping only two or three inches above the ground in the roadways, much like *Thanaos icelus*. At rest, the wings are held erect and almost attingent, the antennæ in a plane with the body, divaricate at an angle of 135°, the curved tip in the same plane with the rest; the trunk is raised at a slight angle with the surface of rest." It loves to rest on birch bushes, around which it flies, in the low open woods near Oberursel (Fuchs). In the duchy of Anhalt the males appear freely some ten days before the females (Gillmer). It is said to be extending its range in certain parts of Germany, *e.g.*, Sommer records that it was first observed in Upper Lusatia at the end of May, 1880, at Lichtenau-Lauban, but, in 1890, it was very common there, as well as in the neighbourhood and surrounding district of Görlitz, as well as other places, and, by 1895, was common near Siegersdorf. Slater says that it has, in our own woods, a habit of dodging about in the hazel bushes and undergrowth, and soon gets out of condition, especially in windy weather. Rothschild observes that it

loves to settle on flowers of *Ajuga reptans* in the ridings of our woods; a similar preference having been noted, 60 years before, in the forest of Raismes, near Valenciennes, by Duponchel.

Habitat.—In Britain, the species is exceedingly local, confined to a few counties, chiefly in the midlands, its occurrence outside these being unusual and unexpected. It appears particularly to prefer the ridings of woods, or the fields in their immediate neighbourhood, and, in its Lincolnshire strongholds, one reads of its preference for the ridings of Legsby Woods (Court), of Wragby Woods (Raynor), etc. It is also noted as occurring in a wood at Uppingham (Kaye). Raynor says that, in the Lincolnshire woods, between Lincoln and Wragby, it haunts the ridings or rough roads through the woods that are cut through the undergrowth, the margin of which, on each side, consists chiefly of lime, oak, sallow, birch and hazel. Although the imagines may be found in the smaller grass-grown paths intersecting the ridings at right angles, he has never, himself, found it on the outskirts of the woods, and feels tolerably sure that it does not frequent them. It is common in the forests of the North of France, and in clearings and ridings of damp woods (Duponchel), extremely abundant in the forest of Rennes (Oberthür), in rather elevated woods around Autun (Constant), in the arid woods of the lowlands of Alsace (Peyerimhoff), and flies commonly among the herbage in damp spots, near woods, in the neighbourhood of the Certosa di Pesio (Norris). Around Geneva, this species occurs either on very rough ground, *e.g.*, mountain gorges, or, in the plains near, or on, the paths through woods consisting mostly of scrub-oak, and meadows not far from the same (Muschamp). Usually it is noted as occurring in the lower valleys of the mountains of Central Europe, but failing in the higher mountains, *e.g.*, at Baden, Alsace, etc., yet it is recorded as being abundant in the woods and damp fields about the Glacier de Trient (Favre), and on the Maloja (Frey). Miss Fountaine found it on the top of the Maloja Pass, on some marshy ground at the foot of the mountains there, facing south, whilst Wheeler says that, in Switzerland, it is generally distributed in grassy woods, but very seldom common, also occurring in the lowlands and hills, and in some places reaching to the mountains. It occurs in a wood on the sides of Mount Besimauda, near the Certosa di Pesio (Lowe), in the mountain valleys of the Enns district of Austria (Brittinger), the Saas valley (Jones), the lovely Anzasca valley (Lowe), the Rilska valley in Bulgaria (Nicholl), and the Oythal in the Allgäu Alps (Dadd). The neighbourhood of woods, however, is its more usual habitat, and Miss Fountaine notes it as occurring in the Szaar, a large forest about 80 kilomètres from Budapest; Duponchel says that it is abundant in the forest of Raismes, near Valenciennes, flying in the ridings and clearings of the woods, resting very frequently on flowers of *Ajuga reptans*. In Hanover, in meadows by the sides of woods (Glitz); at Aix-la-Chapelle, in the Burtscheid and Aachen woods (Stollwerck); in meadows near woods near Barmen, and in open woods near Elberfeld (Weymer); on the borders of the woods between Kloppenheim and Igstadt, and in the Mombach wood, on wooded slopes facing south near Wiesbaden (Rössler); in the ridings of woods near Hanau (Limpert); open places in woods near Giessen (Glaser); in open places in wooded districts in the Wetterau and the Taunus (Koch); in grassy openings, and on the

roads in woods at Waldeck (Speyer); in dry deciduous woodlands in the Dessau Haide (Stange); on the forest roads, ridings in woods, bare places and meadows in the Mosigkau Haide district (Gillmer); common in woods near Mühlhausen (Speyer); in meadows near woods and in bushy places, locally, among the foothills of Silesia (Döring); in meadows near woods at Dresden (Steinert); in small meadows near woods, or on the borders of woods, near Regensburg (Schmid); in the woodland meadows between Deuringen and Strassberg (Freyer); in open places near Kempten (von Kolb); everywhere in the forest roads in Württemberg (Keller); in the valleys of the Black Forest, but not ascending into the mountains (Reutti); in the plains and foothills of the Salzburg district, haunting the flowery and grassy mountain meadows, the meadows near woods, etc. (Richter); in the Tyrol, it is to be found from the lower levels to the lower alpine region, not rare in the lower valleys and the lower forest region (Weiler). Its connection with damp situations is occasionally noted, *e.g.*, common in damp places in the Oberharz (Hoffmann); in damp deciduous woods near Rudolstadt, and on the borders of the Beuche (Krieghoff); in damp shady roads in woods, or on the borders of woods, near Zeitz-on-Elster (Wilde); in damp meadows near Dessau (Richter); in damp deciduous woods on the foothills of the Province of Silesia (Wocke); and Lowe observes that, in his experience in Switzerland, Austria and Italy, although the species has usually only occurred to him singly, it appears to like a certain amount of shade and damp situations. Eversmann says that it prefers damp grassy places in woods in the Lower Volga district, and Caradja that it haunts openings in woods, and lowlying grounds in Roumania. Scudder says that the butterfly is most frequently found to haunt the flowers by roadsides, passing through thickets or woods, especially the latter, if they are open enough to let the sun enter freely; at Copper Cliff, Ontario, Harrington notes it as abundant along the short wood road leading up along the brook to the meadow; Bean says that, at Laggan (Rocky Mountains of Alberta) it chiefly frequents grassy meadows along the Bow river, at an altitude of 4800ft.-5000ft.; and Mrs. Nicholl observes that the insect is common in British Columbia, and in all the valleys along the United States' boundary up to 6000 ft., the examples not varying at all from European specimens.

Localities.—Exceedingly local in England; not recorded from Scotland or Ireland. Beds: Clapham Park Woods (Abbott), near Luton (Westwood). [Berks: Beaumont (*Ent.*, xvii., p. 217) (wants confirmation).] Bucks: Stony Stratford (Foddy), Linford Wood (*Ent.*, xvii., p. 217). Cambridge: White Wood, near Gamlingay (Abbott). Devon: near Dartmoor (Jermyn), near Torquay, Ponds Gate, Dartmoor, near Ashburton (Walker). [Dorset: Swanage (Fowler), wrongly recorded; corrected *Ent.*, xxxii., p. 309.] [Gloucester: one reported (Hudd).] Moreton-in-the-Marsh, two specimens (Hopkins *teste* Perkins). Hants: Netley Abbey, near Southampton (Harvey), Southwick (Moncreaff), [Winchester (List 1871)]. Hunts: Monks Wood (Doubleday), St. Ives, local (Norris). Lincoln: near Wragby, Langworth, Legsby, Linwood (Raynor), Lincoln (Mackonochie), Skellingthorpe, Newball (Carr), Legsby Woods, near Market Rasen (Court), Ashby, near Brigg, Market Rasen (Cassal), Bourne (*teste* Stainton), Langworth Wood, abundant (Fowler), Ropsley Wood, near Grantham (Brameld). [? Montgomery: Blaenau-Festiniog (Hughes, *Ent.*, xv., p. 256), wants confirmation.] Northampton: Castor Hanglands, Milton, near Peterborough (Henderson), Oundle (Doubleday), Kettering (Sturgess), near Towcester (Clark), Barnwell Wold, Ashton Wold (Bree), Helpston, near Peterborough (Morley), Wansford (Vipan), Northampton (Battley), Rockingham, Whittlebury Forest, Yardley Chase

(Goss). Notts: near Newark (Brameld), Stapleford (Gascoyne), West Bridgford (Simmons). Oxford: Wychwood Forest (Draper), between Woodstock and Enstone (Bree). Rutland: Uppingham (Kaye). [Somerset: Taunton, one reported (Griffiths).] Suffolk: Stowmarket (*teste* Stainton). [Surrey: Mickleham (Beattie) (almost certainly an error, wants confirmation badly).] Worcester: Berrow Hill, Martley (Edwards), Craycombe (*Trans. Worc. Nat. Club*).

Distribution.—Central Europe (except Denmark), Finland, central and southern Russia, Pyrenees, Piedmont, Dalmatia, ? Bithynia, Armenia, Labrador and Boreal America (Rebel). America: see *anteà*, pp. 196-201. Asia: throughout central Asia—Amurland (Elwes), Southern Siberia—Ost-Sajan (Oberthür), Manchuria—Isle of Askold (Oberthür), Armenia—Borjom (Romanoff), etc. Austro-Hungary: Bohemia—near Bürglitz, not common (Nickerl), Senftenberg (Fritsch), Upper Austria, throughout (Speyer), Steyer, Wels, Enns district, etc. (Brittinger), the Traun and Mühl districts—Pfenningberg (Himsl), near Kniedorf, Gradenälm (Hander), Freistadt, Linz (Fritsch), Lower Austria, generally distributed—Vienna, not rare (Rossi), in the Prater, and mountain valleys near Vienna (Speyer), Kalksberg (Rebel), the Rohrwald (Fountaine), Hernstein district (Rogenhofer), Salzburg, distributed but singly — plains and foothills, *e.g.*, at the foot of the Kuhberg, Gers- and Gaisberg, near Nockstein, etc. (Richter), near Salzburg (Fritsch), Tyrol, in the lower parts—near Innsbruck, Tratzberg (Enzenberg), Seiser Alpe (Gredler), Sarnthal, Bozen, Meran (Settari), Val Popena, the Dolomite district (Mann), Pejo (Lemann), Castelrutt, in the Sarnthal (Speyer), Taufers valley (Weiler), near Trafoi (Lowe), Plätzenwiese (Mann), Carinthia—in the Bauer's Wiese, near Raibl (Mann), Schwarzenbach (Hofner), Carniola (Speyer), Dalmatia—Zara (Pregl), Spalato (Mann), Banat, Transsylvania, distributed (Czekelius), Galicia (Garbowski), Hungary—Buda-Pest district, throughout (Aigner-Pavel), Forest of Szaar (Fountaine), Austrian Alps—Nassfeld (Hormuzaki), the Bucovina, distributed in valleys (Hormuzaki), Styria—around Gratz (Dorfmeister), Barnschütz (Trost), Croatia—Hraszt, near Fiume (Mann). Belgium: Kincampois, Hertogenwald, Campine, Ghlin (Donckier), Yernée, common (Radiguès), Theux, not rare (Mairlot), Warnant, rare (Lambillion), Luxembourg forests—Vallée de l'Ourthe, Hockay, not rare (Sibille), Ortho (Slégers), Etalle (Habran). Bosnia and Hercegovina: widely distributed up to 1000 mètres—Dervent, Maklenpass, Gacko (Hilf), Klekovaca (Apfelbeck), Trebevic (Rebel). Bulgaria and East Roumelia: Rilo district—the Rilska valley (Rilokatal) (Nicholl), near Sophia (Drenowski). Finland: rare (Zetterstedt), Karelia (Lampa). France: widely distributed but local, Brittany—Rennes, very common, Oise—Chantilly (Oberthür), Seine-et-Oise—Forêt de St. Germain (Bellier de la Chavignerie), Forêt de Bondy (Guenée), Paris district—Vincennes Fontainebleau, Arminvilliers, etc. (Berce), Ille-et-Vilaine — Morbihan (Griffith), Indre — Brenne (Martin), Nord — Forêt de Raismes, near Valenciennes (Duponchel), et de Clair Marais (Paux), Allier — Chavagnac (Peyerimhoff), Indre — Forét de St. Chartier (Sand), Brenne (Martin), Auvergne—Guéret, Mont Dore (Sand), Cher—St. Florent, Aube—Larivan, Bois de Bailly (Sand), Puy de Dôme (Speyer), Sâone-et-Loire, rather rare—Autun (Constant), Haute-Savoie--Chamonix (Oberthür), Alpes-Maritimes—Lantosque valley (Millière), Haute-Garonne—Lac d'Oo, Port de Venasque (Rondou), French Pyrenees, at low levels—St. Sauveur, etc. (Rondou), Dauphiny—Chambery (Salvin), Doubs (Bruand), the French Juras of the Geneva district (Muschamp), Maine-et-Loire — Baugé, Milly (D. Roy). Germany: Prussia, rare and local—Memel, Löwenhagen, Tapiau, Frischingwald, Zehlau-Bruch, Johannisberg—Danzig (Speiser), Pomerania — near Endingen, Pennin, Zarrenthin (Hering), Mecklenburg-Schwerin and Mecklenburg-Strelitz (Schmidt), Hanover — near Hanover (Reinhold), near Osnabrück, Hameln, Osterode, near Göttingen, common (Jordan), Brunswick — near Brunswick, Wolfenbüttel, not rare (Heinemann), Helmstedt, near Quedlinburg (Jordan), Oberharz, somewhat common (Hoffmann), Harz-Rand and Vorberge (Speyer), Westphalia—near Münster (Speyer), near Höxter (Jordan), Rhine Provinces—in the Burtscheid and Aachen Wald, common, Cologne, Mülheim, Bonn, Elberfeld, Boppard, Bingen, Trier (Stollwerck), near Barmen, Neviges, Hilden (Weymer), near Neuenahr (Maassen), Hesse-Nassau, etc.—Mombach Wald, between Kloppenheim and Igstadt, near Wiesbaden (Rössler), near Oberursel (Fuchs), near Hanau (Limpert), Oberhessen—Giessen, Friedberg, Hungen (Glaser), near Wilhelmsbad, in the Wetterau, the Taunus, in the Weilthal, and near Schlangenbad (Koch), near Cassel, Lindenberg, Fuchslöcher (Borgmann), in theStiftswald, near Kaufungen

(Knatz), Waldeck, near Rhoden (Speyer), Rotenburg (Jordan), Thuringia—Steiger, near Erfurt, Schmücke, near Burgwenden, near Arnstadt, Gotha, Rudolstadt, near Jena, Eisenberg, near Liebenstein (Krieghoff), Krahnberg, Boxberg, Seeberg, Lau-Leuchaer Holz (Knapp), on the Veronicaberge, near Martinsroda (Gillmer), near Weimar, in Osterland (Speyer), Province of Saxony—Zeitz-on-Elster (Wilde), the Dessauer-Haide (Stange), near Mühlhausen, near Neuhaldensleben (Speyer), near Naumburg, Sondershausen, and on the Kyffhäuser (Jordan), Brandenburg—near Berlin, Finkenkrug (Rey), Silesia, in the plains and foothills, fails in the Riesengebirge (Wocke)—near Brieg, the Zobtenberge (Döring), in the Seefeld, near Reinerz (Standfuss), Görlitz (Möschler), Upper Lusatia, near Lichtenau-Lauban, near Charlottenhof, on the Rotstein, Siegersdorf (Sommer), near Oberleschen, Modlau, near Donabrunnen, Sprottau (Pfitzner), in the Glatzer Gebirge, near Fürstenstein (Speyer), Kingdom of Saxony—Dresden district—on the Edlen Krone, in Priessnitzgrunde, near Dippelsdorf (Steinert), Saxon Upper Lusatia—near Quoos, near Elstra, Löbau, Rotstein, Seifhennersdorf, Rachlau (Schütze), near Chemnitz—Wittgensdorf, Herrenhaide, Frankenberg, Waldkirchen (Pabst), near Leipzig (Speyer), Bavaria—Regensburg, Etterzhausen, Schutzfelsen, Weintinger Holz (Hoffmann), near Munich—Isarauen, etc. (Kranz), near Augsburg, Strassberg, Lech-Ebene (Freyer), near Kempten (von Kolb), near Uffenheim (Speyer), Württemberg—everywhere in the woods (Keller), Stuttgart (Seyffer), Baden—widely distributed in the Black Forest district, fails in the highest parts (Reutti), Thurmberg, Durlach Wald, Hardtwald (Gauckler), Alsace—Fronhöltz, Colmar, La Chapelle, Strassburg, Ergersheim (Peyerimhoff), Freiburg (Lowe), Allgäu district—the Oythal (Dadd), Bavarian Pfalz (Bertram), near Mainz rare, near Heppenheim (Speyer), in the Bergstrasse (western Odenwald) (Glaser). GREECE (Merlin coll.). ITALY: Lombardy—Monti di Vill'Albese, rare (Turati), Val Strona, Val Anzasca (Lowe), Tuscany (Rossi), Piedmont—Certosa di Pesio, the Besimauda (Lowe), common on Monte Metajur (Norris), woods of Mandria, Stupinigi, Val di Pesio (*teste* Speyer), Susa (Lowe). NETHERLANDS: Limburg—Maurrissen, Schaalsberg, near Valkenburg (Snellen). ROUMANIA: Grumazesti, Kloster Neamtz (Caradja). RUSSIA: Baltic Provinces—Pichtenwald (Nolcken), Œsel (Frey coll.), Kasan district, Ural district—foothills of the Ural, Sergievsk, Saratov, Sarepta (Eversmann), Caucasus district (Bramson), St. Petersburg (Speyer), South Bessarabia (*teste* Fleck). SCANDINAVIA: Sweden—rare in south (Zetterstedt), Helsingland (Siebke), Jämtland (Meves), Lapland (Rudolphi), Norway—Alten (Schneider), Hunneberg (Lampa), to Oplorig, near Kolverid, 65° N. lat. (Collett). SWITZERLAND: distributed throughout—from the Juras to the Voralpen (Frey), Grisons—Bergün, rare (Zeller), Davos (Killias), Maloja (Frey), Kandersteg, Inden (Harcourt-Bath), the Axenstrasse (Hutchinson), near Lake of Lucerne, Fluelathal, Dischmathal, Flims (Fison), on the Zürichberg, in Höcker-on-the-Albis, Wallisellen (Dietrich), Lauterbrunnen district (Moss), Simplon (*teste* Speyer), Engelberg (Lowe), Geneva district—Bois des Frères, Vuache, Gaillard, Grande Gorge on the Salève (Muschamp), Versoix, Hermance, Onex, Martigny (Blachier), between Göschenen and Wassen (Keynes), Brunnen, Andermatt (Jones), just above Sépey, Veytaux, Mt. Barry (Wheeler), Aigle (Sheldon) Villars (Lowe), Glacier de Trient, La Forclaz, Martigny, Sierre, Bex, Colombière de Fully, etc. (Favre), Vionnaz (Wheeler), Macolin (Lowe), Immensee (Solly), Saas-im-Grund (Jones), Weissenburg—common up to 3300 ft. (Huguenin), Les Plans (Fison), Turtmannthal (Buckmaster), Orsières (Baker).

## Family: HESPERIIDÆ.

This family has already been described under the name of *Hesperiinae* (*antèa* p. 84), and is divisible into at least two well-marked subfamilies: (1) The *Phocidinae*, named from the *Phocidae* of Hübner, of which *Phocides*, Hb. (type *palaemon*, Cram., *nec palaemon*, Pall.), is one of the typical genera; (2) *Hesperiinae*, containing the typical genus, *Hesperia*, Fab. (type *malvae*, Linn.) These two families roughly include the Astycid sections of Hübner, *i.e.*, *Celebres* (excluding *Pyrrhopygae*), *Fortes*, *Formales*, *Veteres*, *Vulgares*, *Cauti* (excluding the *Mysceli*), and *Juvenes* (excluding the *Carysti* and *Cobali*) (*op. cit.*, pp. 102 *et seq.*). The *Phocidinae* is an almost entirely New World subfamily, only a few genera, with one or two species each, occurring in

the Old World. The ♂ usually provided with a costal fold on the forewing, occasionally with a tuft on one of the wings, and frequently with a tuft of long hairs attached to the hind tibiæ, which are usually, but not invariably, furnished with two pairs of spurs. The epiphysis on the front tibia is invariably present. The subfamily *Phocidinae* is diagnosed by Watson (*Proc. Zool. Soc. London*, 1893, p. 15) as follows :—

Antennæ with club usually bent into a hook, but sometimes sickle-shaped, always terminating in a fine point. Third joint of palpi, either minute or else porrected horizontally in front of the face (as in the Ismenid section of the *Pamphilidae*), never curving over the vertex. Cell of forewings always more than two-thirds the length of costa. Discocellulars generally very oblique; nervure 5, slightly nearer either to 4 or 6, never conspicuously close to either. Hindwing frequently with a tail or tooth at submedian; nervure 5, never fully developed, except in a few Old World genera.

## Subfamily: Hesperiinæ.

This subfamily contains most of the European Hesperiids—*Erynnis alceae*, etc., *Hesperia malvae*, etc., *Nisoniades tages*, etc. It occurs throughout both the Old and New Worlds, some of the genera being very widely distributed. One of the main features of the subfamily is the presence, in many genera, of a distinct costal fold in the forewings of the ♂s, a character, however, that is much more common in the New, than in the Old, World species. In many of the genera, also, the ♂ is provided with a tuft of long hairs attached to the hind tibiæ or fore coxæ. There are, invariably, two pairs of spurs on the hind tibiæ, and the epiphysis of the tibiæ of the front legs is almost invariably present. The species of many of the genera appear to rest with their wings flat, and not drawn up over their backs as in the Urbicolids. The subfamily is diagnosed by Watson (*Proc. Zool. Soc. London*, 1893, p. 16) as follows:

Antennæ seldom hooked, occasionally bluntly pointed. Palpi, with the 3rd joint either minute or porrected in front of the face, in the latter case, stout (and not slender as in the Entheid group of the *Phocidinae*); palpi never curving over vertex. Forewing, cell less than two-thirds the length of costa; nervure 5, invariably nearer to 6 than to 4. Hindwing frequently lobate, but never with a distinct tail or tooth at the submedian; nervure 5, never fully developed.

The ♂s of most of the species of this group possess, as noted above, a costal fold, often obscure, on the basal half of the forewings, which encloses a silky down composed of delicate scales. Scudder says (*Butts. of New England*, ii., p. 1639) that "this costal fold is a most remarkable structure, remarkable chiefly because here, and only here, in butterflies, the marginal vein is developed to any appreciable degree; here it is as highly developed as any other vein, and the membrane between it and the costal vein being exceptionally broad, it folds back upon the upper surface so as to lie next the costal vein; so that, though the marginal vein is developed, it does not practically form the margin, but, as in the ♀, that function is given to the membrane in front of the costal vein, here doubled upon itself. The purpose of this reflexion of the costal margin is to form an enclosure, within which may be concealed the androconia, probably scent-scales, whose odour is probably so delicate that it needs to be bottled up, as it were, within this concealment, and, indeed, the closure of the fold is so admirable that it is often difficult to tell whether or not there be a fold. Within this fold are several distinct sorts of scales,

each having its own special field, and these are, in general, the same throughout the group, *i.e.*, each separate pavement or area bears its own peculiar scales, which, though they vary to a considerable degree, even in species of the same genus, are, nevertheless, generally reducible to a single type distinct from the others."

Scudder diagnoses the subfamily (*op. cit.*, pp. 1373-4) under the name *Hesperidi*, which he then divides into two sections, *Eudamini* and *Antigonini* of Mabille, the former of which he says differs a little from the latter, in the mode in which the wings are held in repose, in which respect they generally resemble, as Wallace has remarked (*Trans. Ent. Soc. London*, 2nd ser., ii., pp. 263-4), the majority of butterflies, all the wings being equally erect. They also differ from them in the greater stoutness of the body, and their remarkable swiftness of flight, which Wallace believes, exceeds that of any other insects, the eye not being able to follow them as they dart past, and the air, forcibly divided, gives out a deep sound, louder than that produced by the humming-bird itself. "These higher genera, too, are almost wholly peculiar to America, and entirely absent from Europe, while the lower forms, *Antigonini* of Mabille, are common to both continents, and, in the temperate zones, are, perhaps, nearly equally abundant in both. In these lower forms, the wings are either perfectly, or almost perfectly, expanded, or else they begin to show an inequality of position, mostly peculiar to the tribe below." Wallace's statement (*op. cit.*, pp. 263-4) that the group, consisting of the genera *Pyrgus*, *Nisoniades* and *Achlyodes*, have "the upper wings, more or less convex, and never erect them in repose," is not accurate, either of Palæarctic or Nearctic species. Scudder's *Hesperidi*, sect ii., is described (*Butts. New Engl.*, ii., p. 1445) as having:—

Egg: With vertical ribs much higher on the shoulder than below, the cross lines only moderately frequent, and the cells less elongated than in the preceding section. Larva (newly-hatched): With the dorsal thoracic shield inconspicuous. Larva (mature): With the head distinctly broader than high; frontal triangle not distinctly carinate; dorsal thoracic shield not conspicuous. Pupa: With the mesonotum not so long as its greatest width; cremaster slight, elongated. Imago: Comprising species of small size; hindwings rounded; median forking sooner than subcostal vein on hindwing; club of antenna sickle-shaped; last palpal joint linear, four or more times longer than broad. Wings fully expanded in repose by day. Genera—*Thanaos*, *Pholisora*, *Hesperia*.

The eggs of the subfamily, are longitudinally ribbed and transversely lined (see pl. iii., figs. 1-2), and differ greatly from those of the Urbicolines (pl. i., figs. 1-6). The larvæ are much thicker and heavier, and live on plants, other than grasses, to which the Urbicolines appear to be almost exclusively attached. The pupæ are smooth, rounded, covered with short hairs, and altogether different in form and general appearance from the slender, pointed (at nosehorn and anus), and very active Urbicolines. The pupa, too, is supported in its puparium by a few slight threads fastened over the body, whilst the Urbicoline pupa has an anal pad, girth, and often also nose-hooks, by which it is attached to its cocoon.

### Tribe: Hesperiidi.

The tribe *Hesperiidi*, which contains the Fabrician genus *Hesperia*, agrees almost exactly with the *Vulgares* of Hübner, diagnosed simply as possessing species, which have "the wings black, with lighter

spots," his main coitus, *Pyrgus*, containing *malvae*, to which Stephens, in 1835, restricted the genus (see *anteà*, p. 85), so that *Pyrgus* falls, as also do *Thymele*, Fab., and *Syrichtus*, Bdv., as a synonym of *Hesperia*, Fab. (see *anteà* pp. 84-85). This tribe of rather small species is very characteristically marked, the typical form of wing-markings being that so clearly seen in the tesselations of *Hesperia malvae*. The tribe is diagnosed by Watson (*Proc. Zool. Soc. Lond.*, 1893, p. 64) as follows:—

Antenna with club robust, arcuate, blunt at tip, no terminal crook. Palpi suberect; second joint laxly clothed with longish scales, third joint slender, blunt, almost concealed in scaling of second joint. Forewing with inner and outer margins subequal; cell less than two-thirds the length of costa; nervure 12 reaching costa well before the end of cell; discocellulars suberect, the lower the longer; nervure 3, shortly before end of cell, more than twice as far from 2 as from 4; nervure 2 nearer base of wing than to end of cell. Hindwing usually evenly rounded, occasionally slightly crenulate; nervure 7 very shortly before end of cell; discocellulars and nervure 5 very faint; nervure 3 immediately before end of cell; nervure 2 nearly equidistant from base of wing and end of cell. Hind tibiæ with two pairs of spurs.

Speyer, in 1878, under the name of *Scelothrix*, Ramb. (*Can. Ent.*, x., pp. 147-148, 164-169), separated the genus *Hesperia*, as restricted in this work, from the rest of the *Hesperiidi*, which he described under the name of *Pyrgus*, Hb., subdividing the latter into:—

Sect. A.—♂ with costal fold.

(*a*) Stoutly built species, with deeply waved-toothed hindwings, and with transparent spots on the forewings—*lavatherae*, Esp., *althaeae*, Hb., *alceae*, Esp. [Erynnis, Schrk. Type *alceae*.]

(*b*) Hindwings more deeply dentated, or with the margins entire; forewings without transparent spots—*proto*, Esp., *tessellum*, Hb., *cribrellum*, Ev. [Muschampia, n. g. Type *proto*, Esp.]

Sect. B.—♂ without costal fold. Hindwings slightly dentated.

(*a*) Club of antenna longer than in the other species, bent behind the middle, and thence to tip much reduced. ♂ with a trace of the costal fold—*poggei*, Led. [Sloperia, n. g. Type *poggei*, Led.]

(*b*) Club of antenna straight or only slightly bent, rounded at tip—*phlomidis*, H.-Sch., *sao*, Hb., *orbifer*, Hb. [Powellia, n. g. Type *sao*, Hb.]

Watson also subdivides the group (*Proc. Zool. Soc. Lond.*, 1893, pp. 64-65), although his sections do not quite agree with those of Speyer. He makes them fall into the following divisions, on their secondary sexual characters, all of which divisions, however, appear to us to have full generic value:—

1. Male without costal fold and without tuft of hairs on hind tibiæ—*spio*, L., *sataspes*, Trim., *zebra*, Butl., *galba*, Fab., *evanides*, Butl., *diomus*, Hopff., *osterodia*, Trim., *dromus*, Plötz, *vindex*, Cram., *transversaliae*, Trim., *orbifer*, Latr., *sao*, Hb., *phlomidis*, H.-Sch., *geron*, Wats. [Powellia, n. g. Type *sao*, Hb.]

2. Male with a costal fold; no tuft of hairs on the hind tibiæ, but with these tibiæ furnished with numerous short spines—*cribrellum*, Evers. [Favria, n. g. Type *cribrellum*, Evers.]

3. Male with a costal fold but with no tuft of hairs on the hind tibiæ—*tessellum*, Hübn., *gigas*, Brem., *nomas*, Led., *poggei*, Led., *proto*, Esp., *americanus*, Blanch., *syrichtus*, Fab., *montivagus*, Reak. [Muschampia, n. g. Type *proto*, Esp.]

4. Male with a costal fold and with a tuft of hairs on hind tibiæ—*cashmirensis*, Moore, *cacaliae*, Ramb., *serratulae*, Ramb., *alveus*, Hb., *andromedae*, Wallgrn., *centaureae*, Ramb., *hypoleucos*, Led., *malvae*, Linn., *cynarae*, Ramb., *carthami*, Hb., *sidae*, Esp., *antonia*, Spey., *sinicus*, Butl., *maculatus*, Brem., *bocchoris*, Hew., *fulvovittatus*, Butl., *trisignatus*, Mab., *asychis*, Godt. [Hesperia, Fab. Type *malvae*, L.]

Watson notes that all the species of this group in which the male has a tuft of hairs on the hind tibiæ, are also provided with a pair of

scabbard-shaped scaly and hairy appendages, springing posteriorly from the breast at the base of the hindlegs, and about one-third the length of the abdomen. These appendages appear to be present in the males of all genera which are provided with tufts on the hind tibiæ, and, when the hindlegs are drawn up, the tuft is inserted between the appendages and the base of the abdomen.

## Genus: HESPERIA, [Fabricius,] Cuvier.

SYNONYMY.—Genus: **Hesperia [-Urbicola]**, Fab., "Ent. Syst.," iii., 1, p. 353 (1793). **Hesperia,** Cuv., "Tabl. Elem.," p. 592 (1798); Latr., "Hist. Nat.," xiv., p. 124 (1805); "Consid. Gén.," p. 208 (1810); Leach, "Edin. Encycl.," ix., p. 130 (1815); Ochs., "Die Schmett.," iv., p. 34 (1816); Dalm., "Vet. Ak. Handl.," xxxvii., p. 202 (1816); Latr., "Enc. Meth.," p. 784 (1819); Sam., "Ent. Comp.," p. 242 (1819); Godt., "Hist. Nat.," i., p. 240 (1821); Bdv., "Eur. Lep. Ind. Meth.," p. 26 (1829); Meigen, "Eur. Schmett.," p. 60 (1830); Dup., "Hist. Nat.," supp. i., p. 257 (1832); Treits., "Die Schmett.," x., p. 247 (1834); Curtis, "List," 2nd ed., p. 316 (1837); Rbr., "Lep. Faun. And.," pl. viii., fig. 15 (1839); Zett., "Ins. Lapp.," p. 915 (1840); Evers., "Faun. Volg.-Ural.," p. 84 (1844); H.-Sch., "Sys. Bearb.," p. 154 (1846); Speyer, "Geog. Verb.," p. 290 (1858); Newm., "Brit. Butts.," p. 170 (1869); Kirb., "Ent. Syn. Cat.," p. 614 (1871); Scudd., "Proc. Am. Ac. Arts, etc.," x., pp. 187-189 (1873); Kirby, "Eur. Butts.," p. 63 (1882); Scudd., "Butts. New England," ii., p. 1527 (1889); Wats., "Proc. Zool. Soc. Lond.," p. 65 (1893); Meyr., "Handbook," etc., p. 356 (1895); Kirby, "Handbook," etc., p. 10 (1897); Grote, "Proc. Sth. Lond. Ent. Soc.," p. 59 (1897); Staud. and Reb., "Cat.," 3rd ed., p. 97 (1901); Lamb., "Pap. Belg.," p. 292 (1902). **[Papilio-Plebeius-] Urbicola,** Linn., "Syst. Nat.," 10th ed., p. 485 (1758); 12th ed., p. 795 (1767); Fab., "Syst. Ent.," p. 535 (1775); Esp., "Schmett. Eur.," p. 345, pl. xxxvi., fig. 5 (1777); ii., p. 149 (1781); Goeze, "Ent. Beit.," ii., pt. 3, p. 108 (1780); Fab., "Spec. Ins.," pt. 2, p. 137 (1781); Bergs., "Nomen.," p. 67, pl. xl., figs. 8-9 (1780); Fab., "Mant.," ii., p. 91 (1787); Bork., "Sys. Besch.," i., pp. 187, 288 (1788); ii., 237 (1789); Brahm, "Ins. Kal.," ii., p. 363 (1791); Haw., "Lep. Brit.," p. 52 (1803). **Papilio,** Linn., "Faun. Suec.," p. 285 (1761); Scop., "Ent. Carn.," p. 181 (1763); Hufn., "Berl. Mag.," ii., 1, p. 66 (1766); Fuess., "Verz.," p. 32 (1775); Schiff., "Schmett. Wien.," 1st ed., p. 159 (1775); Retz., "Gen. et Spec.," p. 31 (1783); Schneid., "Sys. Eur. Schmett.," p. 277 (1785); Geoff., "Fourc. Ent. Paris.," p. 247 (1785); Don., "Brit. Ins.," xv., p. 71 (1795); Hübner, "Eur. Schmett.," pl. xcii., figs. 466-7 (1802); text p. 71 (*anteà*, 1805); "Larv. Lep.," i., Pap. ii., Gens E*b*. figs. 1*a-d* (*circ.* 1800); Ill., "Schmett. Wien.," 2nd ed., p. 143 (1801); Ochs., "Die Schmett.," i., 1, p. 208 (1808); Freyer, "Neu. Beit. Schmett.," iv., p. 126 (1842). **[Papilio-] Plebeius,** Müll., "Faun. Frid.," p. 37 (1764). **Pamphila,** Fab., "Ill. Mag.," p. 287 (1807). **Thymale,** Oken, "Lehrb. Zool.," i., p. 758 (1815). **Pyrgus,** Hb., "Verz.," p. 109 (1816); Stphs., "Illus.," iv., p. 405 (1834); Humph. and Westd., "Brit. Butts.," p. 120 (1841); Stphs., "List," 1st ed., p. 21 (1850); Westd. and Hew., "Gen. Diurn. Lep.," p. 517 (1852); Stphs., "List," 2nd ed., p. 19 (1856); Kirby, "Eur. Butts.," p. 119 (1861); Butl., "Cat. Diurn. Lep.," p. 282 (1869); Rühl, "Pal. Gross.-Schmett.," i., pp. 677, 831 (1895). **Thymele,** Stphs., "Ill. Brit. Ent.," i., p. 97 (1828); "Ins. Cat.," p. 26 (1829); Wood, "Ind. Ent.," p. 9 (1839); Sta., "Man.," i., p. 65 (1857). **Syrichtus,** Bdv., "Icones," etc., p. 231 (1832); Dup., "Cat. Méth.," p. 36 (1845); De Vill. and Guenée, "Tabl. Syn. Lep. Eur.," p. 120 (1835); Wallgrn., "Skand. Dagf.," p. 274 (1853); Hein., "Schmett. Deutsch.," p. 113 (1859); Curò, "Bull. Soc. Ent. Ital.," p. 215 (1874); Auriv., "Nord. Fjär.," p. 41 (1888). **Syricthus,** Bdv., "Gen. et Ind. Meth.," p. 37 (1840); Led., "Verh. zool.-bot. Ges.," ii., p. 26 (1852): Kane, "Eur. Butts.," p. 143 (1885); Dale, "Brit. Butts.," p. 222 (1890). **Syrichthus,** Dblday., "Syn. List," p. 2 (1850); Snell., "De Vlind.," i., p. 81 (1867); Nolck., "Lep. Faun. Estl.," p. 82 (1868); Staud., "Cat.," 2nd ed., p. 34 (1871); Frey, "Lep. Schweiz," p. 53 (1880); Lang, "Butts. Eur.," p. 344 (1884); Barr., "Lep. Brit. Isl.," p. 268 (1893); Tutt, "Brit. Butts.," p. 122 (1896). **Scelotrix,** Ramb., "Cat. Lep. And.," p. 76 (1858). **Scelothrix,** Speyer, "Can. Ent.," x., pp. 148, 166 (1878).

In 1793, Fabricius (*Ent. Syst.*, iii., p. 258) separated the Ruraiids and Urbicolids from the rest of the butterflies under the name

*Hesperia*. Practically, he merely renamed the Linnean *Plebeii*, which contained the same groups, and he retained the Linnean subdivisions thereof—*Rustici* and *Urbicolae*—so that, instead of the Linnean sections—*Plebeii: Plebeii-Rustici, Plebeii-Urbicolae*, we have the Fabrician subdivisions—*Hesperia: Hesperia-Rustici, Hesperia-Urbicolae*. Owing, however, to Fabricius noting *Hesperia* as a division equal to *Papilio*, and not as a division of *Papilio*, the name has been allowed to stand, although from the classificatory point of view a mere synonym of *Plebeii*. In 1798, Cuvier cited (*Tabl. Elem.*, p. 588) *malvae*, Linn., as the type of *Hesperia*, Fab., which rendered void Fabricius' later action (*Ill. Mag.*, vi., p. 277), when, in 1807, he restricted *Hesperia* to a section of "blues," of which *boetica* was one, and erected *Thymele, Helias* and *Pamphila* for the skippers. The diagnosis of Fabricius for *Hesperia* reads (*Ent. Syst.*, iii., p. 258) as follows:—

> Palpi duo compressi, hirti, apice cylindrici nudi. Antennæ clava oblonga, sæpius uncinata.

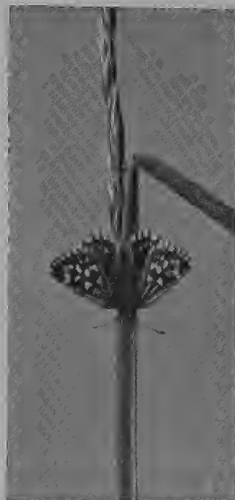
Cuvier evidently did not clearly understand the action of Fabricius in renaming the Linnean *Plebeii*, for, after quoting the Linnean *Plebeii*, with *Papilio argus*, Linn., as type, he notes: On a séparé nouvellement du genre des papillons:

> Les Hespéries (*Hesperia*, Fabr.) dans lesquels le renflement des antennes est pointu, la tête grosse, et qui tiennent ordinairement les ailes horizontales, ou du moins ne les relèvent qu'a demi. Leurs chenilles ont seize jambes, et se filent une coque—Le P. de la mauve—*P. malvae* (Petit; ailes d'un brun foncé, parsemées de taches blanches).

The restricted genus *Hesperia*, with *malvae*, Linn. (*alveolus*, Hb.), as type, is, as already noted, very closely allied to the genera *Favria* (*cribrellum*), *Muschampia* (*tessellum, nomas, proto, syrichtus*, etc.), *Powellia* (*spio, orbifer, sao, phlomidis*, etc.) *Sloperia* (*poggei*) (see *anteà*, p. 218), from which, however, it can be at once separated by the presence, in the ♂, of a costal fold to the forewings, and also a tuft of hairs on the tibiæ of the hindlegs. The genus, under the name of *Scelothrix*, Ramb., with the species *maculata*, Brem., *sidae*, Esp., *cynarae*, Ramb., *carthami*, Hb., *alveus*, Hb., *serratulae*, Ramb., *cacaliae*, Ramb., *andromedae*, Wallgrn., *centaureae*, Ramb., *malvae*, Linn., was separated from the rest of the allied species (grouped as sections of *Pyrgus*, Hb.), by Speyer (*Can. Ent.*, x., p. 148) (see *anteà*, p. 218). His diagnosis of *Hesperia* (= *Scelothrix*, as above restricted) reads as follows:—

> Club of antenna elongate, ovate, somewhat compressed, feebly falcate, rounded at the end. Locklet long; palpi projecting more than length of eyes beyond front, the middle joint bristly, the apical joint thick, bluntly conical, horizontal, or directed obliquely forwards. Hind tibiæ without spines. Male with much-developed costal fold; two membranous, sheath-formed appendages on the metasternum, and a long hair-tuft on the hind tibiæ. Tuft of hind tibiæ composed of long, fine, pencil-like hairs.

The metasternal appendages are a pair of almost linear, rather flat, membranous, apparently hollow structures, at first sight to be compared with a short, broad, sabre-sheath, thickly-scaled on the front edge, and particularly at the tip, with longer hairs. The hind tibial tuft arises close under the knee of the hind tibiæ on the inner side. It is composed of fine, long, pencil-like hairs, and is always as long, often considerably longer, than the tibiæ; when drawn in, it appears to be placed under the sheath-like metasternal appendages. He observes that the genus approaches very near to *Pyrgus* in the



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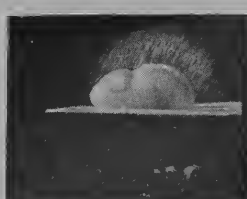

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*Photo. Hugh Main.*

HESPERIA MALVÆ IMAGO AND PUPA. CHRYSOPHANUS DISPAR LARVA AND PUPA.

*Natural History of British Butterflies*, Dec., 1906.

## Plate XIX.

*(To be bound facing Plate XIX.)*

### Hesperia malvæ.

Figs. 1-3.—Imago just emerged from pupa and climbed up grass stem.

Fig. 2.—Shortly afterwards (the insect reversed and crawled some distance down stem and rested).

Figs. 4-8.—Pupa (five different views) $\times 2$.

### Chrysophanus dispar var. rutilus.

Fig. 9.—Larva (spun up for pupation) $\times 1$.

Fig. 10.—Pupa (lateral view) $\times 1$.

Fig. 11.—Pupa (dorsal view) $\times 1$.

general appearance, markings, and habits of its species, but in the ♂s certain conspicuous differences separate them readily, and, in the matter of the tibial tuft and metasternal appendages, there appear to be no transitional forms. The species are extremely difficult to separate, and the specific or varietal value of many species is very uncertain. The genus appears to be practically confined to the Palæarctic and Nearctic regions.

Scudder observes (*Butts. New Eng.*, ii., p. 1530) that the butterflies are of small size, and may be readily distinguished by their chequered markings of white upon a dark brown ground, the markings generally disposed in transverse series, especially across the middle and outer half of the wing . . . . the undersurface of the hindwings peculiarly variegated, lacking the regularity of the markings of the other parts, different shades of brown, olive and yellowish-green serving to enliven the general design, while an interrupted fringe to all the wings adds to their tesselated appearance. He further notes that the group is one of the most numerous in species among the *Hesperiidae*, and finds its maximum of development in the north temperate regions of the Old World, most of the species found in North America being confined to the western part, whose fauna bears a closer resemblance to that of the Old World than it does to that of eastern North America. In the Old World, it extends from about 60° N. lat. to nearly 30° N. lat., and, in the central Alps of Europe, one species (*Hesperia alveus*) at least goes up to 7500ft. In the New World it extends on the east coast, including the Antilles, at least from below the equator to 55° N. lat., and on the western coast nearly as high.

The butterflies choose a variety of situations in which to live—dry meadows, open places in woods, roadsides, mountain valleys, and high upland pastures; they rest on flowers, their wings expanded flatly when flying actively in the sun, although, when quite at rest, they are drawn up vertically over their backs. Some of the species are exceedingly fond of drinking at muddy puddles and runnels of water; we have seen near Simplon, and elsewhere, a bank, through which water was oozing, steaming in the hot sun, so covered with specimens of *Hesperia alveus*, of both sexes, that it would have been possible to cover several dozens with a net had one been so disposed.

### Hesperia malvæ, Linné.

Synonymy.—Species: **Malvae,** Linn., "Syst. Nat.," 10th ed., p. 485, no. 167 *nec* larv. (1758); 12th ed., p. 795, no. 267 (1767); "Faun. Suec.," p. 285, no. 1081 (1761); Müll., "Faun. Frid.," p. 37 (1764); Fab., "Sys. Ent.," p. 535, *nec* larv. (1775); Fuess., "Verz.," p. 32, no. 609, *nec* references (1775); Goeze, "Ent. Beit.," ii., pt. 3, p. 108 (*in part*) (1780); Fab., "Spec. Ins.," pt. ii., p. 136 (*nec* larva et pupa) (1781); Retz., "Gen. et Spec.," p. 31 (1783); Schneid., "Sys. Besch. Eur. Schmett.," p. 277 (1785); Geoff., "Fourc. Ent. Paris.," p. 247 (1785); Brahm, "Ins. Kal.," ii., p. 363 (1791); Lewin, "Insects," etc., p. 96, pl. xlvi., figs. 8-9 (1775); Cuv., "Tabl. Elem.," p. 592 (1798); Haw., "Lep. Brit.," p. 52 (1803); Don., "Brit. Ins.," xv., p. 71, pl. 567, *exc.* larv. et pup. (1813); Leach, "Edin. Encycl.," ix., p. 130 (1815); Dalm., "Vet. Ak. Handl.," xxxvii., p. 202 (1816); Sam., "Ent. Comp.," p. 242 (1819); Bdv., "Icones," p. 231 (1832); Zett., "Ins. Lapp.," p. 915 (1840); Humph. and Westwd., "Brit. Butts.," p. 120, pl. xxxviii., figs. 1-6 (1841); Kirby, "Eur. Butts.," p. 119 (1862); Wallgrn., "Skand. Dagf.," p. 274 (1853); Nolck., "Lep. Fn. Estl.," p. 82 (1868): Butl., "Cat. Diurn. Lep.," p. 282 (1869); Newm., "Brit. Butts.," p. 170 (1869); Kirby, "Syn. Cat.," p. 614 (1871); Staud., "Cat.," 2nd ed., p. 34 (1871); Curò, "Bull. Soc. Ent. Ital.," vi., p. 215 (1874); Kirby, "Eur. Butts.," p. 63 (1882); Lang, "Butts.

Eur.," p. 344 (1884); Kane, "Eur. Butts.," p. 143 (1885); Schilde, "Berl. Ent. Zeits.," p. 55 (1886); Auriv., "Nord Fjär.," p. 41, pl. vii., fig. 9 (1889); Wats., "Proc. Zool. Soc. Lond.," p. 65 (1893); Rühl, "Pal. Gross. Schmett.," i., pp. 677, 831 (1895); Meyr., "Handbk.," p. 356 (1895); Tutt, "Brit. Butts.," p. 122 (1896); Kirby, "Handbook," etc., iii., p. 10 (1897); Staud. and Reb., "Cat.," 3rd ed., p. 97 (1901); Lamb., "Pap. Belg.," p. 292 (1902). ?**Morio,** Scop., "Ent. Carn.," p. 181, var. 2 (*exc. cit.* Rœsel) (1763). **Fritillum,** Schiff. and Den., "Schmett. Wien.," 1st ed., p. 159 (1775); [Hb., "Eur. Schmett.," pl. xcii., figs. 464-5 (1802);] text, p. 71 (*ante*, 1805); Latr., "Consid. Gen.," p. 208 (1810); Ill., "Schmett. Wien.," 2nd ed., p. 143 (1801); Latr., "Hist. Nat.," xiv., p. 124 (1805); Hb., "Verz.," p. 109 (1816); Godt., "Hist. Nat.," i., p. 240, pl. xii. *sec.*, fig. 3 (1821). **Malvae-minor,** Esp., "Schmett. Eur.," pl. xxxvi., fig. 5 (1777). **Sao,** Bergs., "Nomencla.," p. 67, pl. xl., figs. 8-9 (1780); Bkh., "Sys. Besch.," i., pp. 187, 288 (1788). **Lavaterae,** Fab., "Mant. Ins.," ii., p. 91 (1787); "Ent. Syst.," iii., p. 353, no. 339 (1793); "Ill. Mag.," p. 287 (1807). **Alveolus,** Hb., "Eur. Schmett.," pl. xcii., figs. 466-7 (1802); pl. cxvi., fig. 597 (1805); "Larvæ Lep.," i., Pap. ii., Gens E*b*., figs. 1*a-d* (*circ.* 1800); Ochs., "Die Schmett.," i., pt. 2, p. 208 (1808); iv., p. 34 (1816); Hb., "Verz.," p. 109 (1816); Stphs., "Ill. Brit. Ent.," i., p. 97 (1828); "Ins. Cat.," p. 26 (1829); Bdv., "Eur. Lep. Ind. Meth.," p. 26 (1829); Meig., "Eur. Schmett.," p. 60, pl. lviii., fig. 2 (1830); Treits., "Die Schmett.," supp. x., pt. 1, pp. 95, 247 (1834); Stphs., "Ill.," etc., iv., p. 405 (1834); Ramb., "Faun. And.," p. 316, pl. viii., figs. 14-15 (1839); Wood, "Ind. Ent.," p. 9, fig. 75 (1839); Bdv., "Gen. et Ind. Meth.," p. 37 (1840); Freyer, "Neu. Beitr.," iv., p. 126, pl. 361, fig. 2 (1842); Evers., "Faun. Volg.-Ural.," p. 84 (1844); Dup., "Cat. Meth.," p. 36 (1845); H.-Sch., "Sys. Bearb.," p. 154 (1846); Stphs., "List," 1st ed., p. 2 (1850); Dbldy., "Syn. List," p. 2 (1850); Westd. and Hewits., "Gen. Diurn. Lep.," p. 517 (1852); Led., "Verh. zool.-bot. Gesell.," ii., p. 26 (1852); Stphs., "List," 2nd ed., p. 19 (1856); Sta., "Man.," i., p. 65 (1857); Speyer, "Geog. Verb.," p. 290 (1858); Ramb., "Cat. Lep. And.," p. 76 (1858); Hein., "Schmett. Deutsch.," p. 113 (1859); Snell., "De Vlind.," p. 81 (1867); Frey, "Lep. Schweiz," p. 53 (1880); Dale, "Brit. Butts.," p. 222 (1890); Barr., "Lep. Brit. Isl.," p. 268, pl. xxxvii., figs. 1-1*f* (1893). **Cardui,** Latr., "Enc. Méth.," ix., p. 784 (1819).

Original description*.—*Papilio Plebeius malvae.* Alis denticulatis divaricatis nigris albo maculatis. "Fn. Suec.," i., tab. 3; Pet., "Gaz.," t. xxxvi., fig. 6; Merian, "Eur.," i., t. 48; Réaum, "Ins.," i., t. 11, fig. 6-7; Roes., "Ins.," i., pap. 1, t. 10; Wilk., "Pap.," 54, t. 2, c. 1. Habitat in *Malva*, *Althaea* [Linné, *Syst. Nat.*, 10th ed.,

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* At the time this description was written, no differentiation of the allied Hesperiid species had been made, and these references include such, although the description itself has been proved to belong to the species with which we are here dealing. Zetterstedt says (*Ins. Lapp.*, p. 915) of *H. malvae*: "Dalm., Hesper. Sv. 202, 6, certe. *Papilio*, Linn., Fn. Sv., 1081, verus (dum affinium nullus alius est cum quo confundi potest). *Hesperia fritillum-minor*, Fabr., "Ent. Syst.," 3, 1, 350, 333 (quatenus Linn. synon. verum)," etc. Wallengren says (*Skand. Dagf.*, p. 275): *Pap. malvae* sine dubio est haec species. Habitat primo vere in pratis. Linné in sua *Fauna Suecicae* dixit, quod cum alia specie suecana hujus generis nullo modo convenit, quoniam *S. alveus* mense Julio, *S, serratulae* et *andromedae* ad finem Junii et in initio Julii, et *S. centaureae* mense Junio reperiuntur; *S. alveolus* ,Hb., tamen jam initio Maji in pratis occurrit. Præterea loco citato legimus; alæ supra nigro-fuscæ, quod in *Syrichtum serratulae* et *andromedae*, qui habent colorem fusco-brunneum, nec in nigredinem vertentem, minime quadrat. *S. centaureae* et *alveus* quidem alas supra nigro-fuscas, fuscas in nigredinem vertentes, habent, sed alæ posticæ *Syrichti alvei* fere sunt immaculatæ, tantum maculis cinereis, obsoletioribus notatæ, dum Linné nullam differentiam coloris alarum posticarum et anticarum in descriptione indicavit, nam dixit; 'alæ maculis parvis seu punctis quadratis albis adspersæ sunt;' et *S. centaureae* non habet maculas quadratas parvas et nullo modo punctas, quod tamen de *Syrichto alveolo* bene dici potest, quoniam ad marginem exteriorem alarum tam anticarum tam posticarum maculas albas, quæ sub nomine punctorum bene sint referendæ, in eo reperimus. Hoc certe quidem sufficit, ut eo nomen Linneanum tribuemus, quare etiam Celeb. Dalman l. c. jam observavit; 'Haec (*Hesperia*) certissime *P. malvae*, Lin., verus, cum a speciebus affinibus nulla alia occurrit qui confundatur.'"

p. 485 (1758)]. [*Papilio malvae*, alis denticulatis divaricatis nigris albopunctatis. (Fn. 794. Hoffn., "Ins.," 4. t., 2 f. ult. Pet., "Mus.," 35, n. 325. Papiliunculus fuscus punctis plurimis albicantibus. "Gaz.," 56, t. 36, f. 6. *Papilio fuscus*, etc. Aet. Ups., 1736, p. 23, n. 34. *Papilio* alis erectis obtusis dentatis nigris; punctis albis, tesselatis. It. Œland, 3. *Papilio* hexapus, alis divaricatis denticulatis nigris albopunctatis.) Habitat primo vere in Pratis. Descriptio: Magnitudo *Argi*. Corpus totum et alæ supra nigro fuscæ. Alæ maculis parvis seu punctis quadratis, albis, numerosis adspersæ sunt a parte exteriori, margine quasi dentato, interjacentibus maculis albis. Corpus et alæ subtus griseo-cinereæ; alæ ipsæ subtus maculis albis difformibus inæqualis magnitudinis. Antennæ clavatæ, supra fuscæ, subtus albidæ, annulis minimis albis. Alæ erectæ non sunt, sed divaricatæ, fere uti *Phalaenae quercifoliae* (Linné, *Fauna Suecicae*, 2nd ed., p. 285).]

Imago.—25mm.-27mm. in expanse. All four wings blackish, with a slight greyish-green tinge, chequered with white or creamy-white spots, many of which are almost square; the fringes alternately made up of white and black patches. Underside of forewings grey, with the white spots of upperside conspicuous; that of hindwings, ochreous, with white marks of upperside enlarged and increased.

Sexual dimorphism.—The special characteristics of the ♂ are: (1) A narrow fold along the basal portion of the costa. (2) A thick sprinkling of greenish-grey scales at the base of the forewings. (3) A more complete central white band on the hindwings. (4) A trace of other white spots usually towards the base of both fore- and hindwings. The ♀ is almost black in colour, sometimes with a faint purplish tinge; the spots are somewhat contracted, and the pattern shows a much more marked contrast than in the ♂. The undersides of the hindwings of the ♂ are dull greyish-ochreous, but, in the ♀, the ochreous is often of a bright ruddy hue. The costal fold is really the turned-up costal edge of the forewing, so that it forms, with its scales, the roof or upper surface of a tube or passage [(compare more detailed description of that of *Nisoniades tages*) (*posteà*).]. At the bottom of this tube is a great number of androconial scales, closely attached to each other, and a broad band. The androconia are, in this species, broadest at the base, about 0·011mm., and always become narrower towards the apex, drawn over in a long very fine point, their length running to 0·25mm. Besides this, there is, in the ♂ s, a spot near the inner side of the posterior tibiæ, which is thickly beset with long evenly broad hairs, forming together a tuft, which the insect is said to be able to spread out or contract at will* (Aurivillius).

Teratological specimen.—A notch at the apex of all the wings, in which the cilia are present, but shorter than usual (Mansbridge).

Variation.—Considerable variation exists in the depth of the ground colour and extent of the white markings. Sometimes the white spots on the forewing occupy the greater part of its central area, and form the ab. *taras*, Bergs. (*lavaterae*, Haw.), which is diagnosed by Staudinger, as having "the white spots large and confluent"; at other times the markings of the forewings are normal, but the white spots of the hindwings form a complete central band = ab. *fasciata*, Tutt, whilst

* Fritz Müller believes that he detected in certain Brazilian species a faint scent produced by similar structures.

Schilde describes rather vaguely an ab. *intermedia*, as intermediate between the type and ab. *taras*. The following appear to be the best known forms of the species :—

1. The forewings with enlarged spots, the hindwings with reduced spots (often only the discal showing) = ab. *taras*, Bergstrasser.
2. The forewings typical, the hindwings with reduced spots, as in *taras* = ab. *intermedia*, Schilde.
3. The forewings and hindwings with the white spots not especially enlarged or reduced = *malvae*, Linné.
4. The forewings typical, the hindwings with the white spots united to form a complete central band = ab. *fasciata*, Tutt.
5. The forewings and hindwings both with distinctly reduced white spots (some quite obsolete) = ab. *restricta*, n. ab.
6. Rather larger than the type, the white spots well-developed, and contrasting with the black ground colour = var. *australis*, n. var.
7. Larger than the type, the white spots contrasting strongly with the very black ground colour, the hindwings with a well-developed transverse band of spots = var. *melotis*, Dup.
8. Larger than the type, the forewings greenish-grey, the white spots of a pure tint, one spot in the centre of the row on the hindwings extending towards base = var. *hypoleucos*, Led.
9. The ground colour of the wings brown, instead of black, the markings typical = ab. *brunnea*, n. ab.

The undersides are very variable. The colour of the forewings beneath is grey, of the hindwings grey, ochreous-grey, olivaceous-grey, brown-grey, or brown, with the white spots of the upperside enlarged and increased; in the ♂ the tint is usually dull greyish-ochreous, in the ♀ the ochreous becomes browner, but the colour is, in both sexes, often of a bright ruddy hue (= ab. *rufa*, n. ab.); the peculiar colours of the underside are exceedingly useful to the species, for they render the butterfly most inconspicuous as it sits on a dried flowering stem of grass, its almost unfailing habit when at rest. Raynor says that the most interesting form that he has taken, is that in which the usual dull chocolate of the underside of the hindwing is replaced by a bright red chocolate, imparting a very handsome appearance to the specimen. There are very few references in our literature to the variation of this species, apart from ab. *taras*, and these are too general to be of much service, *e.g.*, an intermediate form captured in South Devon, in 1902 (Rogers); one large example approaching *H. alveus* in size, taken near Bude (Rothschild); several red-brown forms at Ringwood (Fowler), etc. Oberthür writes (*in litt.*) that he has, in his collection, a specimen in which the ground colour of the wings is greyish-white, both above and below, in place of the black = ab. *albina*, n. ab. Mrs. Nicholl states that she has three examples of a small very brown form, taken high in the mountains of Aragon, about mid-July. Frey notes that, on the Albula, he got a ♂, the upperside of which corresponds exactly with that of var. *hypoleucos*, Led., whilst the underside of the hindwings presents the usual markings. Hilf records the capture of very dark examples at Ubli, in the Balkans, in July, 1903. The alpine form of Central Europe, described by Duponchel as *melotis*, with the black ground colour and white spots contrasting distinctly, and with brownish underside of the hindwings with the usual markings, is often united with the eastern (Syrian) greenish-grey, conspicuously white-spotted *hypoleucos*, Led., which further has the underside of the hindwings pale greenish-yellow. We think these two forms should

be kept separate. A form very closely allied to *melotis*, Dup., is quite common in all the warmer parts of southern France—Hyères, Draguignan, Cannes, Digne, etc., whilst the *hypoleucos* of Syria is a very different-looking insect in its extreme forms. Running through the specimens in our own collection we notice: (1) A long series from Saeterstoen, in Norway, June-July, 1898—the ♂ s small, grey-haired, with abundant, but rather small, white spots, tending to join transversely; two ♀ s only, somewhat darker, but spotted almost like the ♂ s, not quite so much white, however. These examples belong no doubt to the typical Linnean form, with abundant spotting exteriorly, without, however, these outer marginal spots developing into ab. *zagrabiensis*, Grund. The undersides fuscous-olive, with well-developed white spots; both sexes the same. (2) A long series from Digne, April, 1897—rather larger than, but otherwise more like, the Saeterstoen specimens than those from Draguignan, Hyères, etc. They are well spotted; the ♀ s are darker, and with rather smaller spots. The undersides of the forewings greyish, of the hindwings, olive-fuscous or brown-grey, a considerable difference existing between the extreme grey and extreme brown forms; the white markings rather mottled. These are very close to the Linnean type in general appearance and spotting. A few ♀ s from Digne are large, black, with well-developed markings, not quite so black in the ground colour, or with such contrasting black spots, as in the real *melotis*, Dup.; we call this ab. (et var.) *australis*. (3) Three ♀ s from Draguignan (May, 1905)—dark, well-marked ♀ s of ab. *australis* form. (4) From Hyères, one ♀, March, 1903, one ♂ and three ♀ s, April, 1905—rather large, the ♂ less in wing-expanse than the ♀ s; dark, with well-developed spots; much larger and darker than those from Saeterstoen; remarkably good examples of the southern form, ab. *australis*; underside hindwings, ♂ rich red-brown; ♀ s olivaceous-brown; the white markings distinct, somewhat silvery. (5) A long series from Cannes, March and April, 1897, 1899, 1900, 1903—♂ s smaller than ♀ s; of the same form as the last, the ♂ s well-marked, but the ♀ s with clear white markings very strongly developed on the forewings, also well-developed on the hindwings, particularly the upper part of the central band. Underside of hindwings grey, olivaceous-grey, and deep olive-brown, well-marked with white. (6) Aix-les-Bains, May, 1897—a well-marked ♀, not unlike some of the Digne examples. (7) Locarno, April, 1899, 1903, and May, 1902—both sexes especially black; the white markings of the forewings, particularly contrasting and reminding one somewhat of those of *carthami*; the hindwings dark with very white spots, in some only a few spots, in others a well-developed transverse band; the undersides olivaceous-brown, in some quite brown, well-marked with white. Undoubtedly the var. *melotis*, Dup. (8) Vernet-les-Bains, July 26th-August 11th, 1905—Two eastern Pyrenean examples from Oberthür of good size, the ♂ slightly larger than the ♀, and powdered slightly with grey at base; both specimens of dark ground colour, white spotting clear; both sexes with outer marginal row on forewings obsolete, on hindwings also, in ♀ rather less so than in ♂; in both sexes only the white discoidal spot of hindwings conspicuously marked. The underside of the hindwings of ♂ brown, of ♀ deep brown (inclining to chocolate); white spots not particularly clear in tint = var. *pyrenaica*, n. var. (9) Canales de la Sierra, two ♂ s, one ♀. Intensely black like the var. *melotis*, spots equally white, but

much smaller, hindwings particularly black with only the discoidal spot (or spots) conspicuous; underside of hindwings of ♂s brown, with white spots almost restricted to central band; of ♀, red, also with restricted white spots = var. *andalusica*, n. var. (10) A ♂ from Cogne, August, 1894. The wings covered with grey dusting; the spots of forewings small, all, except angulated row, more or less obsolete; hindwings as forewings, and only the costal part of transverse row of white spots developed; underside of hindwings pale yellowish-brown, with well-developed white spots = var. *alpina*, n. var. The described forms of this species, so far as they are known to us, are as follows:—

α. ab. *zagrabiensis*, Grund, "Ent. Zeits. Guben," xvii., p. 49, fig. b (1903); Gillm., "Soc. Ent.," xix., p. 34 (1904).—Form, size and ground colour, identical with those of typical *H. malvae*, L., but the spots of the marginal area form a complete white band on the forewings. This band runs from the costa to the inner margin in the same direction as does the row of white spots. The second row of white spots in the median area consists of two large white spots, meeting, so as to form a blackish eye, with the white spot turned to the base of the forewings. The outer row of white spots on the hindwings is obsolete, only represented by a weak whitish dusting, whilst the median transverse row of spots on the hindwings consists of only two short white narrow stripes. The fringes are not chequered, as in the type, but those of the forewings are white, and only once interrupted by a small dash of the dark ground colour just below the middle of the outer margin; three dashes occur in the fringes of the hindwings, but these do not reach the outer edge, the external half of the fringes being quite white. On the underside of the forewings, the spots also form a distinct white band; on the underside of the hindwings there are fewer, but larger, white spots than is the case with the type. Near Agram—Zagrabia (Croatia) (Grund).

Gillmer remarks (*Soc. Ent.*, xix., p. 34) that the ab. *zagrabiensis* differs from ab. *taras* and ab. *intermedia*; (1) in the fringes; (2) in the confluence of the outer row of white spots into a complete band; (3) by the increased size of the white spots on the underside, whilst the spots on the upperside of the hindwings are reduced, similar to those of ab. *taras* and ab. *intermedia*.

β. ab. *fasciata*, Tutt, "Brit. Butts.," p. 123 (1896); Lamb., "Pap. Belg.," p. 293 (1902); Wheeler, "Butts. Switz.," p. 6 (1903). *Malvae* var. *c*, Wallgrn., "Skand. Dagf.," p. 274 (1853). *Moryi**, Strand, "Nyt. Mag. f. Nat.," xl., pt. 2, pp. 141, 163-4 (1902); xlii., pt. 2, p. 132 (1904).—The forewings typical; the white spots forming the central transverse fascia on the hindwings united into a complete central band (Tutt).

Strand's ab. *moryi* appeared to us, at first, to be a very slight modification of ab. *fasciata*, *viz.*, with the transverse band of the underside of the hindwings complete, and, as we were not at all sure whether our ab. *fasciata*, in which the band on the upperside of the hindwings is complete, is always so also on the underside, we were rather doubtful whether ab. *moryi* would come within the limits of ab. *fasciata*. His reference, however, to Wallengren's var. *c* determined the matter, for the description of this form reads: "Fascia macularia media in parte inferiore alarum posticarum continua maculis albis cohærentibus inter costam quadratam et sextam," which is a clear diagnosis of ab. *fasciata*.

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* Strand writes: "*H. malvae* is found abundantly at Odnes, and also in some numbers at Vallo and Roikenviken. Examples of ab. *taras*, Bergs., were not found, but I have a well-marked and quite intermediate specimen agreeing with Wallengren's var. c, in which the white spots of the transverse band on the underside of the hindwings are joined, whilst between the 4th and 6th nervures a white united spot is found. I name this new aberration after my friend Mory in Basle."

γ. ab. *intermedia*, Schilde, "Berl. Ent. Zeits.," p. 55 (1886); Rühl, "Pal. Gross-Schmett.," i., p. 831 (1895); Tutt, "Brit. Butts.," p. 124 (1896). *Alveolus*, Hb., "Eur. Schmett.," p. 71, pl. cxvi., fig. 597 (1805).—Previous to 1885, I gave considerable attention to the variation of this species, and have, as a result, fourteen examples of *taras*, all ♂s; in addition, however, I have eleven specimens of a form intermediate between the type and ab. *taras*, which occurs in both sexes, and which I call *intermedia*. The upperside of the forewings resembles that of the type, but that of the hindwings that of *taras*. Four examples (two ♂s and two ♀s) of this form have, also, the underside of the hindwings similar to *taras*, whilst the other five ♂s and two ♀s have only the upperside of the hindwings of the *taras* form, the underside agreeing fairly well with *malvae*. The difference from typical *malvae*, is, however, considerable. As to the sexual relationship of these forms it is to be noted: (1) All ab. *taras* are ♂s. (2) No ♀ *malvae* has the white marks on the forewings like those of *taras*. (3) No *taras* ♂ has spots C and K on the underside of hindwings (see pl. ii., fig. 1). (4) Both these spots are present in *malvae*. (5) These spots always occur together in *intermedia*, not one or the other alone, as C in *alveus* (fig. 3). (6) In all the *Pyrgus* forms mentioned, spot C may be absent, except in *taras* ♂ and *intermedia* ♂ and ♀. (7) The *sao-orbifer* group, notwithstanding its resemblance to *intermedia* on the upperside, is, on account of the arrangement of the bands and spots on the underside further from the *malvae-taras* group, than the other noted species of *Pyrgus* that have not this similarity on the upperside. (8) Although *antonia* reminds one of *taras* on the upperside of the forewings, the underside is very dissimilar. The development of these forms is connected with sex; the most widely divergent form from the type being only ♂, the ♀ being only transitional; ♂ *intermedia* tend to approach the true *taras* form, which the ♀s do not. The number of *taras* compared with the type, also varies in different seasons, and in different localities (Schilde).

According to Schilde's figures of *taras* (see *infrà*) and description of *intermedia*, it is clear that the latter form had typical forewings, whilst the hindwings have reduced spots, as in ab. *taras*. Oberthür notes that he has 24 examples between ab. *taras* and the type. Löffler (*Ent. Zeits. Guben*, xviii., no. 20) notes that he found ♀ examples of this species, which exhibited a complete transition to ab. *taras*, hitherto only recorded as a ♂ form, and concluded that the species possesses a tendency towards the *taras* markings, the ♀ now beginning to follow the ♂, which first developed the tendency in this direction. Well-marked ♀ *taras* are still very rare.

δ. ab. *taras*, Bergsträsser, "Nomenclatur," etc., iv., p. 40, pl. xci., figs. 5-6 (1780); Latr., "Enc. Méth.," ix., p. 784 (1819); Meig., "Eur. Schmett.," i., p. 61, pl. lv., figs. 3*a-b* (1830); Speyer, "Geog. Verb.," p. 290 (1858); Staud., "Cat.," 2nd ed., p. 34 (1871); Kirby, "Eur. Butts.," p. 63 (1882); Frey, "Lep. Schw.," p. 53 (1880); Lang, "Butts. Eur.," p. 345, pl. lxxxi., fig. 2 (1884); Kane, "Eur. Butts.," p. 143 (1885); Schilde, "Berl. Ent. Zeits.," p. 55, pl. ii., figs. 7-9 (1886): Barr., "Lep. Brit.," p. 269, pl. xxxvii., figs. 1*b-c* (1893); Rühl, "Gross-Schmett.," pp. 679, 831 (1895); Tutt, "Brit. Butts.," p. 124 (1896); Kirby, "Handbook," etc., iii., p. 11, fig. (1897); Staud., "Cat.," 3rd ed., p. 97 (1901); Löffl., "Ent. Zeit. Guben," xviii., pp. 77-78 (1904). *Malvae* var., Esp., "Schmett. Eur.," pl. li., fig. 2 (1780). *Althaeae*, Esp., "Schmett. Eur.," ii., pp. 4, 149 (with ref. to pl. li., fig. 2) (1781). *Fritillum**, Fab., "Mant.," ii., p. 91 (*teste* references) (1787); "Ent. Syst.," iii., p. 353 (*teste* references) (1793); "Ill. Mag.," p. 287 (1807); Lewin, "Insects," etc., p. 96, pl. xlvi., figs. 4-5 (1795); Stphs., "Ins. Cat.," p. 26 (1829); Humph. and Westd., "Brit. Butts.," p. 121, pl. xxxviii., figs. 7-8 (1841); Kirby, "Syn. Cat.," p. 614 (1871). *Altheae*, Bork., "Sys. Besch.," i., pp. 188, 288 (1788); ii., p. 237 (*teste* references) (1789). *Lavaterae*, Haw., "Lep. Brit.," p. 52 (1803); Bdv., "Gen. et Ind. Meth.," p. 37 (1840); Dup., "Cat. Meth.," p. 36 (1845); Newm., "Brit. Butts.," p. 170 (1869); Butl., "Cat. Diurn. Lep.," p. 282 (1869); Dale, "Brit. Butts.," p. 223 (1890). *Alveolus*, Hb., "Eur. Schmett.," figs. 847-8 (*post* 1823).

* The reference (Esp., pl. li., fig. 2) of Fabricius suggests that he was here dealing with *taras*. On the other hand, his description suggests *alveus* or *carthami*. This also was Godart's opinion.

*Alveolus* var., Freyer, "Neu. Beit.," iv., p. 126, pl. 361, fig. 3 (1842).—*P.P.U. taras.* Alis dentatis divaricatis, fuscis, albo-maculatis, punctatisque. Wings irregularly dentated, dark brown, with white spots and dots. If this insect is a distinct species as Scriba asserts, then the name *taras* would be more correct than that of *morio*, as Scopoli called it*. In size and appearance, it is like *sao*†, usually, however, it is smaller, and the tips of the antennæ, which are very prominent in other species, are almost entirely covered with hair; the ground colour, the spotted outer border and pattern of the hindwings resemble those of *sao*; the markings of the forewings are also similar, but the three innermost are very conspicuous, much larger than the others, while that nearest the lower margin is long and broad; on the underside is the pattern of the upperside, and the ground colour is greenish-grey-brown (Bergstrasser). British localities.—Berks: Wokingham (Hamm). Cambridge: Chippenham Fen (Rothschild). Cornwall: Bude (Mathew). Devon: South Devon (Rogers), Dartmoor (Gummer), Woodbury (Kane), Exeter (South), Lustleigh (Buckell), Plymouth (Lemann), Oxton (Studd), Instow (Hinchliff), Torrington, Barnstaple (Mathew). Essex: Epping (Gerrard), Hazeleigh (Raynor). Gloucester: Leigh (Hudd), Gloucester (Merrin), Painswick (Metcalfe), Wotton-under-Edge (Perkins). Hants: Isle of Wight (Mitford), Ringwood (Fowler), Brockenhurst (Wells). Middlesex: Old Oak Common, Kingsbury (Godwin). Oxford: Cowley (Shipp). Surrey: Woking (Russell), Godstone (Turner). Sussex: Hastings district (Bloomfield), Abbott's Wood, Battle (Jenner), Milton (Adkin), St. Leonard's (Sweetlove), Horsham (Jackson), Tilgate (Sheldon). Continental localities.—Asia: Asia Minor—Brussa (Fountaine). Austro-Hungary: Dalmatia (Mann), Lower Austria—Hernstein, etc. (Rogenhofer), Schallmoss, near Salzburg (Richter), Glockner (Mann), Carinthia—Wolfsberg (*teste* Rühl). Belgium: Marchovelette, Beez, Fond d'Arquet, Gedine, Brussels, St. Servais, province of Luxembourg (Lambillion). Bosnia and Hercegovina: Sarajevo, Vranica Planina, Maklenpass (Rebel). Denmark (Lampa). Finland: Karelia (Lampa). France: Riviera (*teste* Rühl), Indre—Branche d'Ardentes, St. Florent (Sand), Seine-et-Loire (Constant), Pont de l'Arche (Dupont), Haute-Garonne, Arguenos—Pic de l'Entricada, Pyrenees (Caradja), Calvados (Fauvel), Brittany (Griffith), Aube—Larrivour (Jourdheuille), Autun (Constant), Rennes, Besançon, Mont Revard, Sologne, Châteaudun (Oberthür). Germany: Pomerania (Hering), Hamburg (Zimmermann), Lüneburg (Machleidt), Hameln, Osnabrück, Hanover, Göttingen (Jordan), Wiesbaden (Rössler), Oberursel (Fuchs), Cassel (Borgmann), Waldeck (Speyer), Osterland, Crefeld, Elberfeld, Trier, Aachen (Stollwerck), Barmen (Weymer), Giessen, etc. (Speyer), Baden—Gengenbach, Karlsruhe, Pforzheim, Heidelberg, Weinheim (Reutti), Alsace—Forêt de Lutterbach (Gerber), Doller (Michel), Basle, Banks of Weise (Peyerimhoff), Thuringia (Krieghoff), Gotha (Rühl), Brandenburg—Berlin, etc. (Bartel), Posen (Schultz), Silesia (Wocke), Saxony—Dresden (Steinert), Rachlau, Löbau (Schütze), Chemnitz (Pabst), Bavaria—Kehlheim, Grass (Schmid), Kempten (v. Kolb), Wernigerode Leipzig (*teste* Rühl). Greece: Acarnania (*teste* Rühl). Italy: Tuscany—Pian di Mugnons (Stefanelli), Lombardy—Monti di Vill'Albese (Turati). Roumania: Costitcha (Fleck). Russia: Baltic Provinces—Livonia (Lienig), Pichtendahl (Nolcken), Annenhof (Huene). Switzerland: Gadmen, Niesen (Jäggi), Martigny, Sion, Sépey, Gryon (Favre), Veytaux, Aigle (Wheeler), Berne (Flemyng), Weissenburg (Huguenin), Saas-Fée, Hermance, Fernex, Monnetier (Blachier).

This is largely a ♂ aberration, ♀s rarely reaching an extreme stage in the development of the white spots of the forewings. Bergstrasser figures (*Nomenclatur*, pl. 91, figs. 5-6) a specimen, under the name of *taras*, with the forewings very white along the costa, and the central transverse band of white spots strongly developed; the hindwings black with a marginal row of small white spots, and a median white spot only; the underside also with the white specially

* We are unable to satisfy ourselves as to this. Scopoli's *morio* var. 2 reads as follows: "Alis anticis supra albopunctatis; fimbria albo fuscoque varia; subtus albomaculatis, eademque fimbria; posticis utrinque simili fimbria, subtus albo sordidoque variis. Roes., "Pap. Duirn. Cl.," iii., tab. x., fig. 7; Poda, "Mus. Graec.," p. 79, *fritillarius*." In our opinion, Roesel's figure is probably *carthami*, whilst Poda's *fritillarius*, we believe, is an Erynnid (Urbanid). Scopoli's description, however, might very well apply to this insect.

† *Sao*, Bergstrasser = *malvae*, Linnè.

developed, as on the upperside; the hindwings normal. Although none too good, Bergstrasser's figure (1780) is distinctly that of this aberration. Esper's, on the contrary, figured (1780) as "*malvae* var." in the same year, is much better, and his description under the name of *althaeae*, the following year (1781) is also satisfactory. Lewin's figure (1795) under the name of *fritillum*, is also good, as are also those of Hübner, published much later (*circ.* 1823) as *alveolus*. Haworth described it under the name of *lavaterae*, and all three names have been frequently used for the aberration by later authors. It is occasionally found with the type in all the European countries where the latter occurs—Scandinavia, Germany, France, Italy, etc. It occurs now and again in most parts of Britain with the type (see localities *suprà*). Schilde's figures of this form are exceedingly good (see *Berl. Ent. Zeits.*, 1886, pl. ii., figs. 7-9), and students interested in the subject should refer to this writer's notes thereon. Miss Fountaine observes that, in a dry sloping meadow near Broussa, in Asia Minor, at the end of April and beginning of May, 1901, a fair percentage of the *H. malvae* captured, distinctly belonged to the *taras* form. Löffler observes (*Ent. Zeits. Guben*, xviii., pp. 77-78) that, "in the great woods of Heidenheim, Württemburg, in May, 1904, one often observed *H. malvae* flying about in numbers in the ridings, or resting on the blossoms of *Taraxacum officinale*. They were also frequently to be observed sitting on the droppings of cows and horses, sucking the fluids thereof, generally in the early morning between 8 a.m. and 9 a.m. A great deal of variation, transitional between *malvae* and *taras*, was observed, as well as many well-marked *taras*. At this time, the butterflies seemed freshly emerged, and were uncertain on the wing, emergence apparently going on through the morning, till after 10 a.m. During the second week of May only ♂ s of *malvae* and ab. *taras* were taken, but during the third and fourth weeks the females of both forms emerged. As far as I know, the latter have not before been recorded, and the catalogues only mention this aberration as a ♂ form."

ε. var. (*et* ab.) *melotis*, Dup., "Hist. Nat.," supp. i., p. 257, pl. xlii., figs. 1-2 (1832); Ramb., "Cat. Lep. And.," p. 76 (1858); Kirby, "Syn. Cat.," p. 614 (1871); Staud., "Cat.," 2nd ed., p. 34 (1871); Zell., "Stett. Ent. Ztg.," p. 462 (1879); Lang, "Butts. Eur.," p. 345 (1884); Rühl, "Pal. Gross-Schmett.," i., p. 679 (1895); Tutt, "Brit. Butts.," p. 124 (1896); Elw. and Edw., "Tr. Zool. Soc. Lond.," xiv., p. 161, pl. xxiii., fig. 29 (*genit.*) (1898); Staud., "Cat.," 3rd ed., p. 97 (1901).—Expanse 12·5 lines. The upperside of all the wings of a shiny black, finely powdered with twelve or thirteen white spots on the forewings, placed as in the other Hesperiids of the same group, but larger and rounder; the hindwings are traversed medially with a white band, divided into six spots by the nervures, and between this band and the outer border, a series of five white points (spots); beyond these some white shadings at the base; the fringes white, regularly latticed with black; beneath, all the wings are grey-brown with a slight greenish tint; the forewings have the base and apex whitish, with a distinct repetition of a part of the upperside; the hindwings are streaked longitudinally with white rays, between which one sees traces of the upperside band. It occurs in May in the Tyrol and in Switzerland (Duponchel).

This form is rather larger than typical *H. malvae*; the upperside with the white and black markings rather more contrasted. Staudinger diagnoses it none too minutely as "plerumque major, al. post. albicantibus, signaturis confluentibus," whilst Rühl speaks of the ground colour as "greenish-grey in the ♂ s, more olive-brown in ♀ s," of which there is no hint in Duponchel's description (*suprà*). He further

says that "the pale spots, though arranged as in the type, are light yellow in colour, and as large as those of *carthami*," another point in opposition with the original description, the remarks being evidently taken from Lederer's description of *hypoleucos*. We are inclined to refer to Duponchel's variety only those dark examples from the eastern alps (the most brilliantly marked form of the species found in Central Europe); some of the finest of these that we have seen, came from Locarno (and were taken by Dr. Chapman there). They are more marked with white than the equally contrasting Spanish var. *andalusica*, in which the white markings are reduced almost as in ab. *taras* on the hindwing. The southern form, var. *australis*, from the Riviera, shows less contrast in its black and white, and the ♂ s approach, in their frequent grey hairs towards the bases of the wings, the more typical form of northern and central Europe.

ζ. var. *hypoleucos*, Led., "Verh. zool.-bot. Gesell. Wien.," v. p. 193, pl. i., fig. 8 (1855).—This insect is allied to *alveus*, Hb., is of the same size, but with much shorter, broader, and rounder wings than this and the allied species, and the underside is very different; the upperside is greenish-grey, much more olive-brown than in *carthami*; the fringe-markings and spots as in this species, but the latter are of a clearer white, rather larger, and not so sharply angulated on the forewings; the spots of the inner band of the hindwings are also pure white, and one spot in the middle of this band projects considerably, even in dull-coloured specimens (nearly as in *alveolus*), whereas in *carthami*, the whole band consists of regular narrow longitudinal spots dusted with dark atoms, and these are also not so distinctly prominent in *alveus* and var. *fritillum*; on the underside, the forewings are dark grey, towards the costa more greenish; the spots are here also rounder, less distinct from the ground colour, and more yellowish than in the allied species; the hindwings are pale greenish-yellow, darker towards the border, shading more into olive-brown; through the middle of the wing a pale longitudinal streak runs from the base to the border, and the pattern of the upperside is also indicated by lighter, but very ill-developed and indistinct, spots; there are no other markings; the fringes are white, chequered with dark grey, on all the nervures except 1 and 5; the ♂ has also a fold on the costa of the forewings; the club of the antenna is bright rusty-yellow beneath. Flies from May to July in damp places, and is rather scarce. Beyrout (Lederer).

Staudinger unites (*Cat.*, 3rd ed., p. 97) this variety with Duponchel's *melotis*, with the note "ab. albidior." Rühl's reference to *melotis*, as we have already said, is largely based on the above description, and he further notes that "the ground colour of the ♂ s is greenish-grey, of the ♀ s more olive-brown, and the pale spots, though arranged as in the type, are light yellow in colour, and as large as those of *carthami*," but this is hardly borne out by Lederer's description quoted above. Staudinger thinks the form (*sens. strict.*) is confined to the Islands of the Grecian Archipelago and northern Syria, with an intermediate form in the Taurus Mountains. Elwes (as well as Lederer) records it from Beyrout, in Syria. Miss Fountaine says that this form was common in the Lebanon, in May and June, 1901.

η. var. (*an* spec. dist.) *malvoides*, Elw. and Edw., "Trans. Zool. Soc. Lond.," xiv., p. 100, pl. xxiii., figs. 27-27*a* (genit.) (1898); Staud., "Cat.," 3rd ed., p. 97 (1901); Wheeler, "Butts. Swit.," p. 7 (1903).—Three examples taken at Biarritz, July 25th, 1887, a single ♂ from Granada, with all the facies of *malvae*, but very distinct ♂ genitalia. The differences in this respect are shown by figures. The proportion of black hair-scales in the clothing of the second palpal joint appears to be considerably greater in *malvae* than *malvoides*. We should not have ventured to separate these on genetalic characters alone, but the genitalia of six specimens from Denmark, Kreusnach, Rennes, Brittany, Stettin and Brussa, are all absolutely similar, *inter se*, as are the three specimens above mentioned. It will probably be found that *H. malvoides* has a wider range and other distinctive characters (Elwes and Edwards).

Staudinger notes the form as having "the hindwings beneath brownish, and less marked with white spots, the genitalia different, a summer form from southwest Europe," which hardly agrees with the distribution suggested above by Elwes and Edwards.

Egglaying.—The eggs appear to be laid indiscriminately on the stem, in the furrows of the small twigs, the upper- and underside of leaves of bramble, sometimes on the edges of leaves. They may be obtained in confinement by sleeving a ♀ on bramble, wild strawberry, or *Potentilla* in the sun. The eggs are generally placed on the underside, occasionally on the upperside, of a leaf, but much more rarely on the stalk or on the edge of the leaf; when the ♀ chooses bramble, young leaves are selected (Raynor); laid singly on bramble on the stem or upperside of a leaf (Pristo); some sent by Raynor were laid on the undersides of strawberry leaves close against a rib; the egg is of a pale whitish-green colour, matching very fairly the glaucous tint of the underside of a strawberry leaf, a whitish-green common to the undersurface of the leaves of bramble, potentilla, and other usual food-plants of this species (Chapman).

Ovum.—Of a pale whitish-green colour; to the naked eye appearing smooth and round; about two-thirds of a sphere or rather less, but the lower margin is rounded off so that the base is smaller than a correct section of a sphere would be; the width is 0·63mm., and the height about 0·44mm.; the vertical ribs are about 23 in number, and are not very high or marked, nor do the spaces between them form very distinct hollows; they diminish in number to the top, by stopping short and by meeting, and form a rim round the micropylar hollow, to which about 12 are directly attached. This hollow is fairly circular, shallow cup-shaped, about 0·12mm. across, and with a minute rosette of fine cells at the bottom. The secondary ribs are very fine, and are continuous across the vertical ribs, and are about 0·02mm. apart (Chapman, June 20th, 1905). Rather more than half a sphere, circular in horizontal section; diameter about ·7mm.; pale creamy-white (with a suspicion of greenish) in colour; 19 or more well-developed longitudinal ribs extending from base to shoulder of egg; this number, at shoulder, becomes reduced, not by suppression of any of these primary ribs and continuation of others, but by the extinction of all of them, and the development of 9 new ones, each of which originates between two of the primary ribs and is continued to the edge of the micropylar depression. This is comparatively large, the bottom covered with a number of very minute cells. Parallel with the outer margin of the micropylar area is a large number (about 24) of fine transverse ribs, which, curving between two longitudinal ribs, rise and cross the latter, forming apparently a small knob at the point of junction. Viewed from above, 14 of these ribs are observed, dividing the spaces between the longitudinal ribs roughly into small rectangles (Tutt, June 15th, 1896). Globular, with base rather flattened; the shell ribbed rather irregularly with about 18 ribs, and transversely reticulated with very even fine lines, which do not stop at the ribs, but cross them, giving their edges a rough appearance, which is not real, but only caused by the ribs, otherwise translucent, becoming opaque where the lines cross; as usual, a small space on the top of the egg is covered only with very fine concentric reticulation. The colour is very pale green all over (Hellins). Figured pl. iii., fig. 2.

Habits of larva.—The young larva makes its escape by cutting a large round hole through the top of the egg. It then chooses the upper surface of a small leaf of bramble, strawberry, potentilla, or other foodplant, for its home, settling itself along the midrib, and spinning several silken threads overhead for a covering, under which it feeds by eating away the upper cuticle, and, when it has made a blotch of some little extent, moves away and repeats the process on another leaf; as it grows bigger, still choosing the upper surface of a leaf for its standpoint, it forms its covering by drawing down another leaf over it, fastening the edges here and there with stout threads, and feeds away in the cave thus formed. When larger, however, it comes out of its cave occasionally and feeds on leaves near. Its habit is to be very sluggish, and the larva rests with its head curled round sideways towards its tail. The larval caves are not difficult to find on stunted bramble bushes with small leaves, the large juicy leaves of strong bushes apparently offering no temptation. In some districts the more usual foodplant, however, is *Potentilla fragariastrum*. The larva is fullfed at the end of August, remaining apparently dormant for days together eating only at intervals; pupation takes place in mid-September (20th) (Hellins). On July 14th, 1905, several larvæ in, or about to enter, the 3rd instar, received from Dr. Chapman. They were feeding in tents on leaves of cultivated strawberry; placed on plants growing in pots the larvæ did not seem to thrive, probably owing to the dry nature of the leaves. They appeared to be of too lazy or timid a disposition to move from their tents and go to fresh leaves, so leaves were placed in a bottle of water, and to these the larvæ were transferred, being removed to fresh leaves every three or four days; under this treatment they throve much better. On July 26th, they had all reached the 4th stage, and two days later the most forward one entered the 5th stadium, and by August 4th most of them had reached it. They always undergo ecdysis in the tents. Though in the 4th stadium, the larvæ spin the leaves, which form their dwelling-tents, very firmly together, yet they do not spin much silk over the floor of the tent. When in the 5th stage the larva spins a fine silken carpet over that portion of the leaf on which it rests. These tents are made by drawing the edges of the leaflets together and fixing them with silk. Sometimes a larva will rest on the upper surface of the central leaflet and draw the two edges over it, but more often it rests underneath the central leaflet on the veins of one side, and draws down the upper surface of one of the side leaflets to form the cover. The two leaflets are held in place by a few very strong strands of whitish silk. It takes the larva a long time to spin its tent. In order to make the strands sufficiently strong, it has to pass the spinneret over the strand many times.* Yet the silk is strong, for once or twice a larva, even in the last stage, tired of crawling on a paint-brush handle while being examined, has quietly let itself down to the table by a silken thread. When feeding, the larvæ eat away the apical part of the leaves forming their tent, and parts of any other leaves which may be within reach. I have never noticed them feeding quite exposed, except immediately after being re-fed, when they usually nibbled the fresh leaves before building a new tent. They

* August 8th, 1905, watched a young larva of *Augiades sylvanus* making its tube in grass. It passed the spinneret 33 times over one strand, which it had already commenced before I noticed it (Sich).

appear to feed chiefly before 9 a.m. and after 5 p.m. In the later stages, they eat the whole substance of the leaf, and the long white hairs of the strawberry leaves were very conspicuous in their excrement. On August 13th most of the larvæ appeared to be fullfed. They were then more uniform, more indefinite in tint, the bands and markings being less conspicuous, and the green colour in some individuals pervaded all the lateral, and approached the dorsal, area. Two days later the first cocoon was spun; the larvæ leaving their tents and wandering about the crumpled paper at the bottom of the jar, finally went down between the folds of the paper and spun their cocoons. Two which were kept in a glass tube spun-up in their tents (Sich). Lewin, in 1795, noted that the larvæ webbed the edges of bramble leaves together, and from the cover came out a little way to feed, but that the least motion of the leaves caused them to retreat, and if much alarmed, to fall to the ground. He, however, erroneously notes them as fullfed, and pupating, in April.

Larva.—*First instar* (newly-hatched): About 2mm. long; head and prothoracic plate, as well as true legs and middle of anal plate, black; the rest cinereous. Tubercles i and ii placed widely apart, each carrying a forked hair; iii is in normal position, also with a forked hair, but, instead of the branches being curved apart so as to be nearly in the same plane, parallel to the larval surface, they stand up so as to make the hair Y-shaped; the stem is also rather shorter than in i and ii; they are about 0·1mm. high, a trifle longer measured across the curved branches; those on i and ii are rather larger but do not stand quite so high owing to their bent-down tips; those on tubercles iv and v are not quite so long and are simple hairs, the anterior rather the higher. There are no other hairs except two (three ?) on the base of the prolegs. The head has certain simple hairs, those on the prothorax are also simple, the black plate carries five (six ?) on either side. The prothoracic spiracle stands up as a high cone; in front of it is a tubercle with three (simple) hairs, at the bases of the legs are two hairs. On the meso- and metathorax are four hairs on each side in line across the dorsum, of these the two inner are forked; round the anal plate are several simple hairs. The general surface is closely studded with minute brown points, for the most part arranged in longitudinal rows. On the dorsum of the 9th abdominal segment are two dark round marks, they have the appearance of hard scutella. The anal plate has a dark central mark, longitudinal, and below it is an anal comb of about thirteen teeth. Beneath, there appear to be no hairs between those on tubercles iv and v to those at the base of the legs, which are on the 1st abdominal two hairs, one in front of the other; at the same point on the 2nd abdominal the two hairs are in transverse position; on the 7th abdominal there is only one, on the 8th abdominal also, but it is further from the middle line, on the 9th it is further back; there is another small hair nearer the middle in the same transverse line with the other hairs on the 1st, 2nd, 7th and 8th abdominals, but in front of it on the 9th abdominal. The prolegs are practically complete circles, with an outer front half of about ten small crochets, and an inner posterior one of about six much larger ones. The claspers have about fourteen crochets of nearly uniform size (June 27th, 1905). *Second instar:* Head and prothoracic plate black, the rest dark chocolate, relieved by the white bases to the white or colourless hairs; these are now very

numerous; seen from the dorsum the margin of each segment has six hairs, and there are three or four rows above this on each side. The rows are not very definite, but sufficiently so to give an appearance of white longitudinal lines owing to their white bases, three or possibly four above spiracle. There are four subsegments, the first the largest, the next three narrower, with a flat portion behind the last; the whole having a convex surface. The hairs are on the ridges of the subsegments and so give also transverse white lines, but both the longitudinal and transverse lines are irregular and vague enough not to appear so until analysed (Chapman). *Fourth instar:* Length 13mm. Rather slender. Colour brownish-green, the green more prominent on the dorsal area; the mediodorsal line dark; the subdorsal, supraspiracular and spiracular lines pale. Head black, covered with raised lines forming very irregular cells of various contours; in the cells are small tubercles, each bearing a whitish feathered or serrated seta. The prothorax is narrower than the head; it carries a black shield which is divided by a pale mediodorsal line, and is furnished with an anterior row of long white bristles, and one posterior long white bristle, besides several shorter bristles; on the shield on each side of the dividing line is a lenticle; between the shield and the spiracle is a group of three warts, each with a long seta. The meso- and metathorax have each four subsegments, while the normal abdominal segments have five, the first of which is very much the larger; the 8th abdominal has three subsegments and the 9th abdominal apparently but two. The whole surface of the skin is covered with strong spicules, and there is also a covering of white warts, each bearing a white club-shaped seta, the top of which is cut into about five points. There are two sizes of these warts and setæ. They are scattered over the general surface without any readily perceivable order. Besides these there are still larger warts with longer setæ, which no doubt represent the primary tubercles, and may be found in the same situations as those described in the fifth instar (see below), but the setæ of ii and iv are, in the fourth instar, not so deeply cleft at the apex. On the mesothorax in the subdorsal area is a membranous wart with one long hair (seta). On the second subsegment of the meso- and metathorax are two large ochreous lenticles*, one lower down just above iii, and one on the flange. The abdominal segments have a lenticle just below i, and another on the flange below the spiracle. Above the hooklets on the anal claspers is a large dark tubercle without any seta. The anal comb has about eight teeth. In front of the prothoracic legs is a dark transverse slit, the opening of the chin-gland, which, when everted, shows a pair of deep depressions in the centre. The abdominal prolegs have a complete circle of hooks, which, however, is rather weak on the outer posterior quadrant. [*Comparison of fourth with fifth instar:* In the fourth instar the prothoracic shield is distinctly divided by the mediodorsal line; this is much less distinct in the fifth instar. In the fourth instar the lenticles, which, in the fifth instar, occur above the claspers and immediately above the spiracles, appear to be absent. The seta of tubercle ii and that of tubercle iv are not so deeply cleft at the apex, and

* The lenticles of *Hesperia malvae* are rather oval with a pale ochreous pleated border, while the sunken disc is finely pitted and deep ochreous in colour.

the anal comb has fewer teeth.] *Fifth instar:* The fullgrown larva is rather slender, much wrinkled, strongly pubescent, either greyish-purple or greyish-green in colour, with dark and pale longitudinal lines, and with a black pubescent head which appears a little too large, and, as it were, not screwed quite home. Length 19mm. at rest (22mm. when crawling). The head is large, but the much smaller prothorax rather exaggerates the apparent size of the head. The mesothorax is rather wider than the head, and the larva gradually increases in bulk to the 3rd abdominal segment. The 3rd, 4th, and 5th abdominal segments are nearly of equal bulk. The body then gradually decreases in size to the 10th abdominal, which is bluntly rounded. When viewed in profile the dip between the head and mesothorax over the prothorax is not so marked as in some other Hesperiid larvæ, especially as in that of *Nisoniades tages*. Segmental divisions not well marked, though the segmental divisions are distinct. The lateral flange is very heavy. Beneath, the larva is rather flat, though the thoracic legs, as well as the abdominal and anal claspers, are of moderate size. The head is black covered with pale ochreous hairs. The prothorax brown with a purple tint; the shield paler with a black transverse line interrupted in the centre. The mesothorax ochreous with dull purple-grey mottling on the ridges of the subsegments. The metathorax and the abdominal segments are dull greyish-purple or dull green, lighter in colour where the skin is folded, and much mottled with pale dots and dull purple blotches, though less so on the 8th, 9th, and 10th abdominals where the darker colour is less distinct. The difference in general tint between the pro- and the mesothorax and the rest of the larva is very marked. The dorsal vessel appears as a dark line running from the mesothorax to the 10th abdominal segment, but most conspicuous on those segments which bear the ventral prolegs. The dull purple-grey subdorsal stripe is perfectly distinct, running from the mesothorax to the 10th abdominal segment and is, next to the dorsal vessel, the most conspicuous mark on the larva; it is bordered above and below by a pale greenish-grey line. There is a supraspiracular stripe, but it is more broken, and not so well-defined as the subdorsal, though of the same colour. In the lighter-coloured individuals another stripe is visible which runs along the thorax and first four abdominals, between the dorsal vessel and the subdorsal stripe. It may here be noted that in the dark individuals the pale lines only are conspicuous, the dark stripes being merged in the ground colour. The spiracles are ochreous, outlined in brown, and they rest on a thin pale line which, however, is not always visible. Beneath, the larva appears of a darker tint owing to the stronger purplish mottling, except on the 9th and 10th abdominal segments, which are paler in colour. This mottling is caused by the pale tubercular spots breaking through the purple colour which, besides being arranged in the usual above-mentioned stripes, runs transversely along the ridges of the subsegments and longitudinally along the flange and above the claspers. The chin-gland appears as a dark purplish spot. The legs are black with paler rings, those, however, of the metathorax have less black about them. The claspers are dull green with purplish mottling, and the hooklets are brown. Head flattened in front, not deeply cleft between the lobes, suture not well-marked nor clypeal border very distinct; epistoma light grey; labrum with ochreous-brown margin. The surface of the head is

covered with numerous pits divided from one another by high walls; in each pit is a black bead-like tubercle which carries a pale seta; the seta is flattened and pointed, plain on one side and serrated or toothed on the other; besides these, there are several longer quite simple setæ. On each side of the face, not far from the centre, are two round lenticles and another above the ocelli. The whole surface of the skin of the larva is covered with strong spicules; these seem to be formed by the skin being pinched up, as it were, to a point, and forming thereby rays of folded skin running from the point to a short distance all round. One use of these spicules is no doubt to strengthen the skin and yet leave it perfectly pliant. Thickly scattered all over the surface, at more or less regular intervals, but more especially on the ridges of the subsegments, are milk-white tubercles, each crowned with a single somewhat glass-like seta. The tubercles are of two sizes, all smoothed and much raised above the general surface of the skin, which, immediately surrounding them, is pale in colour. The corresponding setæ are also of two sizes, though intermediate sizes also occur. The smaller (0·1mm.) and the larger (0·24mm.) setæ are similar in structure, and there is no doubt that they are of secondary nature. They rise from the summit of the tubercles, are stout and bristle-like, and expand at the apex, where they form a depression surmounted by usually five conical teeth. Round the legs, claspers, and beneath the larva, these secondary setæ, though similar in other respects, are not expanded at the apex, but run gradually to a single sharp point. Besides these, there are still larger tubercles bearing longer setæ of a distinctly different form. These may be the primary tubercles. The single seta of these tubercles is flattened towards the apex, but not expanded, and the apex is deeply cleft, so that there are only two long slender teeth, though sometimes the two teeth are short and conical. When the teeth are long and slender they sometimes lie so close together that the seta appears to end in a single point. These setæ occur in the following positions: On the meso- and metathorax, there is a pair on the dorsal area of the second subsegment, one on each side of the mediodorsal line, and another pair, wider apart, on the 3rd subsegment; these appear to be the trapezoidals i and ii. On the lateral area there is a tubercle which looks like an accessory tubercle, situated on the spot where the spiracle would be if these segments bore spiracles. On the flange are two tubercles a little distance apart, which may be iv and v, and below is another, which may be vi. On the abdominal segments, i is on the 1st subsegment, but ii with a very long seta, retains its position on the 3rd subsegment, iii is above and in front of the spiracle, iv with a very long seta pointing backwards, and v with a shorter seta directed forwards, are subspiracular and some distance apart, and vi is below these with a rather long seta. The seta of tubercle ii and that of tubercle iv measure 0·4mm. in length, and those of the other tubercles i, iii, v and vi about 0·3mm. The prothorax consists of four subsegments, the first two being very small, and having the appearance of wrinkles; the third is large, and bears the transversely elongate shield, a raised tubercular-like swelling just below the shield, crowned with a lenticle and three or four long setæ and some shorter ones, and the large oval spiracle which lies towards the hind margin. The shield bears eight strong whitish setæ and two minute black dots on its anterior border, and

behind these, near the centre, two ochreous black-ringed lenticles, and some smaller setæ; it is nearly cut in two by a fine black embedded transverse line. In front of the spiracle is another lenticle, while below, and anterior to the spiracle, is a large whitish tubercle bearing a stout pointed seta directed forwards; the 4th subsegment is rather narrow. The meso- and metathorax have also four subsegments, the first being very narrow, and the other three more of equal width. On the mesothorax in the subdorsal area, is a lenticle, and just behind the lenticle is a large pale membranous wart with a long fine hair (0·55mm.) on its centre; both wart and hair are remarkable and totally unlike any other dermal warts or setæ of the larva, except the two similar hairs on the posterior margin of the 10th abdominal segment. Above the legs is another lenticle. The metathorax is similar, but the peculiar hair and wart above mentioned are both absent. On the 1st and 2nd abdominal segments, which consist of five subsegments similar to the other normal abdominal segments, there is a lenticle above the spiracle, and another below the spiracle, and a third (and sometimes a fourth) beneath, in the position occupied by the legs in the thoracic segments. The 3rd to 7th abdominal segments have each five subsegments, the first very wide, the second half the width of the first, and the last three much narrower, of nearly equal width; the first subsegment bears two lenticles about its centre, one on either side, and not far from the mediodorsal line, just below tubercle i; the 2nd subsegment bears the rather oval rather raised spiracle, and an oval lenticle above the spiracle anteriorly, another on the fold, and a fourth on the clasper. The 8th abdominal segment has three equal subsegments, the very large spiracle is on the 2nd subsegment; the dorsal lenticles are wanting here, but those immediately above and below the spiracle are present. The 9th abdominal consists of two subsegments of nearly equal width; the dorsal lenticles are here present, and, owing to the smaller area of the 9th abdominal, the lateral lenticles are crowded towards the dorsal so that there is a transverse row of four lenticles; the lenticle on the fold is also present. The 10th abdominal consists of the broad rounded anal flap. Besides the usual secondary setæ, which spring from the posterior border of the anal flap, two long fine hairs may be observed, and one or two setæ which appear less stout than the majority. Below the flap is a strong fold, and below this the claspers. There is a lenticle on the claspers, and on their outer posterior wall a little above the hooklet, is a large, conical, purple-black, horny wart. The pointed tip is directed backwards and the wart is without any seta. Just below the flap some of the teeth of the anal comb are visible. The anal comb is wider and has more teeth (about eleven) than in the penultimate instar (Sich). *Fullfed:* Length 18mm. (22mm. stretched); colour a peculiar apple-green with overlaid yellow, especially where intersegmental membrane overlaps, and with a reddish tone on the thoracic segments; head quite black (but with golden hairs); a darker green dorsal line (really dorsal vessel). Rather nearer the spiracles than to this is a band that suggests a darker tone than that above and below it, and really is so, in so far that it has rather fewer yellow (?) skin-points than the rest of the surface; this band is bounded at each margin by a very narrow and extremely tortuous yellow line; these run from skin-point to skin-point and are of much the same tint as they are. The spiracles are orange. Below these is a marginal flange with comparatively

long hairs. Just above this and halfway (or nearly) to spiracles, skin-points are rare or absent; below it, is again a clear space followed by a second (really third, the first being obsolete) flange with a good many hairs. The subsegmentation of the abdominal segments is proportionally 4 : 1 : 1 : 1 in width; on the 1st subsegment, skin-points are very numerous and irregularly placed; on the 2nd, they are in two incomplete rows; on the 3rd and 4th, they are in one row (at least dorsally). The head is 2·4mm. across, the 1st thoracic 1·6mm., and the broadest portion of the larva is 3·7mm. (from 2nd to 6th abdominal segment). The head is black, really a very deep brown, with golden (very short) hairs; these arise from ordinary hair-bases which are situated at the bottom of cup-shaped hollows. The whole head-surface is pitted with such hollows so closely set that they interfere with each other so as not to be often circular, and frequently want a portion of the margin. Except that the hairs arise from the largest and most perfect of these, so that they seem to be the primary feature of the surface-sculpturing of the head, it would be at least as easy to describe the sculpturing as consisting of a network of fine sharp ridges, with rounded hollows in the interspaces, the ridges being of varying heights. The cups, in fact, form the ridges by intersecting each other and not by being squeezed together. It is futile to describe the mouth-parts without figures; the maxillæ and their palpi are well-developed, and the terminal bristle of the antenna is long (0·5mm.). The prothoracic plate has no median suture, but has a transverse line rather behind the middle; it carries a lenticle on either side near the middle and one at either end; they are small and dark, hardly bigger than the hair-bases. The meso- and metathoracic segments have four subsegments, of the mesothoracic the first is evanescent in the medio-dorsal line, the second projecting forwards. This and the two following are of width as $2\frac{1}{2}$:1:1. The metathorax has the 1st subsegment complete, and the width of the four are as 1:1·5:1:1. The lenticles throughout are small and (except on the thoracic plate) of nearly the same colour as the skin, so that it is extremely difficult to be quite sure of them. There is one on each thoracic segment, rather below spiracular level. On the abdominal segments there is one a little above (and in front of) the spiracle, and a smaller one rather further from it and directly below. There are apparently two close together on the 2nd and 3rd thoracic segments, at level of the upper of these. On the 2nd, 3rd, 4th, 5th, 6th, 7th (not on 1st and 8th) abdominals are two dorsal lenticles, at, approximately, the position of tubercle i. The skin-hairs are very numerous dorsally; on an abdominal segment there are about 100 on a square of the width of the segment. The larger are less numerous, about 0·33mm. long, the shortest are about a fourth of this length; it is impossible to identify any of the longest as being those of primary tubercles. They are all, apparently (large and small), bifid at the extremity, one or two even trifid, but this may be an aberration. Many of the smaller widen out beyond the middle, and terminate in three, four, or even five points, suggesting a relationship to the trumpet-hairs of *Nisoniades tages* larva, and of a Lycænid pupa. Some of the larger hairs are not dissimilar, but two other forms are commoner. One has the shaft widened and flattened, and looks as if two hairs were combined by a thin membrane joining them; these then approach each other terminally, but before meeting end in separate points, with often another between them, on

the membrane. The other divides into two terminally, but looks as if it wanted to divide more deeply. The skin-points are very fine, about 0·02mm. apart, with a compound apex, and with lines, in a somewhat hexagonal pattern, running from one to another. The true legs are fuscous or nearly black, the 3rd joint rather long and narrow; claw brown, short, with battledore palpus; the 1st and 2nd joints have many hairs, the 3rd joint only terminal ones. The prolegs have a complete circle of crochets, larger on inner side. In some specimens the circle has no sign whatever of a break, in others one crochet at inner posterior aspect is slightly separated from its neighbours; the circle could be described as broken if this hook were absent. The hooks are well curved into about three-quarters of a circle; they are in alternate sizes, 29 of each in one instance when counted; the base or pedicel of the leg has numerous true hairs, *i.e.*, simple, ordinary, pointed forms. The anal plate is rounded behind, with sides approximating in front, and is about 1mm. across, and carries numerous true hairs, with very fine filamentous tip, the longest about 0·4mm. long. The anal comb underneath this is about 0·6mm. long, narrower at its base, and spreading to the ends of the spines; each of these seems to arise quite at the base, a rib running down the comb from the base to each point. There are about 10 long ones and 4 or 5 shorter ones on each side (Chapman, August 20th, 1905).

Colour changes in larva.—*First instar* (June 12th, 1874): When *newly-hatched*, its colour is very pale green, with head and collar shining black; every tubercular dot bears a pale bristle, longish and straight on the head and anal segment, but, on the other segments bifid, with the tips curved on either side like an unbarbed double fish-hook. *Month old* (July 9th): About 4mm. long, the colour pale purplish-pink, the head still black. *Five weeks old* (July 17th): About 12mm. long, pale green again, the whole skin thickly set with short straight hairs. [The bifid bristles appear to be lost at the 1st moult.] *Fullgrown* (August): The last moult took place on August 1st; the larva soon attained its full length, 16mm., afterwards increasing only in stoutness. When fullgrown, it is very stout; the head horny, globular, and stuck like a knob on the prothorax, which, however, is not so strikingly narrow as in *Nisoniades tages;* the skin granulated in appearance; the head and whole body covered thickly with short fine pale hairs; the general colour a pale ochreous-green, the prothorax pinkish, and a faint reddish tinge over the back of the other front segments; a thin dorsal, and somewhat broader subdorsal, line, not easy to be seen, of the ground colour, and a faint spiracular line; the spiracles not much darker than the ground colour, ringed with the same tint as the lines; the belly freckled; the head and collar very dark purplish-brown, the upper lip paler (Hellins).

Puparium.—The fullfed larva spins a little cave between two or three bramble-leaves, similar to those in which the larvæ live, but fastened with stouter silk, and the openings protected by a loose, pale, yellow webbing, and, in this, pupation takes place (Hellins). The first point to strike one about the cocoon is that it is made of yellow silk, not of white silk like that used in building the larval tents. This yellow colour appears to be not inherent in the silk, but of the nature of a stain, and applied to the silk after it has left the spinneret. I noticed some of the silk strands were more deeply stained in one part than in others, and

also that the paper in which some of the cocoons were spun was also stained yellowish. In one or two instances there were some yellow threads in the last larval tents, and sometimes the cocoon would be commenced with white silk. The leaves or other materials used in making the cocoon are fastened together by a network, with rather large meshes, of strong, yellow, silken strands. This network also covers any interval there may be between the leaves, but it is not spun on the inner surface of the material which helps to form the cocoon. In the interior there are some fine threads spun about the walls, and, on one side of the interior, a large platform of rather densely-spun yellowish silk is made. On this, the larva clings until pupation takes place. The cocoon is completed in about two days, and the larva rests on the platform for about three days before throwing off the larval skin. When this has been successfully accomplished, the pupa attaches itself to the silken platform by the cremastral hooks. When newly changed, the head, dorsum of meso- and metathorax, the wing-cases (and the limb-cases ?) of the pupa are green, the rest being clear brown, without the dark spots. After 24 hours the green becomes bluish-grey (Sich). The pupa occupies a cocoon formed of a strong lacework of yellow silk. The silk is, as it were, a flat tissue, with numerous circular holes of various sizes. These draw together any surrounding objects; the interior has a very slight coating of silk, to which the cremaster adheres tenaciously (Chapman).

Foodplants.—*Rubus fruticosus* (Hellins), *R. idaeus* (Hübner), *Potentilla fragariastrum* (Harwood), *P. reptans* (Raynor), *Comarum palustre* (Lienig), *Fragaria vesca* (Sich), *Agrimonia eupatoria*, *Coronilla*, *Dipsacus sylvestris* (*teste* Rühl), *Potentilla anserina* (Glitz), [*Plantago lanceolata* (Richter)].

Pupa.—Deep chestnut-brown in colour, with a series of darker (nearly black) markings; the wings and appendages paler, as if nearly transparent, and the green contents shining through, giving a green-olive or brown effect, differing a little in different pupæ. A further obvious feature is the clothing of short pale brown hairs, except on the appendages. A marked and curious feature of the pupa when thoroughly mature is the presence of a white efflorescence or bloom, densest round the prothoracic spiracle. The form of the pupa is characteristically Hesperiid, although it wants the nose-horn and the free proboscis-case of the typical Urbicolid; how far these are confined to Urbicolids, and wanting in Hesperiids, I do not know. The head is very wide, large and distinct; the glazed eyes are very broad, and have the convexity directed forwards, and, being of dark colour, and the area between them and the antennæ being also a little darker than the general surface, give one the (not altogether incorrect) impression of their being very large eyes at either side of the head. Although there is no frontal horn, the middle of the face is quite in front, and the antennal origins are very dorsal. There is quite a "neck" (as seen laterally), the mesothorax curving down in front to the prothorax, which does not continue the curve, but proceeds more forward again. The dorsum, except the forward curve just noted, and a trace of waist at metathorax, is quite straight, it being the normal attitude for the abdominal segments 5-10 to be (apparently) bent backwards, so that the ventral outline is very curved, the dorsal straight; this results in an exaggeration of the projection ventrally of the wing and maxilla

ends. Seen dorsally, the pupa is again widest at end of wings, *i.e.*, at beginning of the 4th abdominal segment, whence it narrows regularly in a straight line to the wing-spine, and thence it falls in suddenly, forming again a "neck" at the thoracic spiracle; backward it tapers progressively in a curve to cremaster. A longitudinal axis of the pupa beginning at the end of the cremaster would be close under the dorsal line, and would come to the surface at anterior margin of mesothorax; one beginning at the most anterior point would be fairly central in the pupa, more truly an axis for the greater part of its length, and would reach the surface posteriorly at the posterior margin of the 6th abdominal segment. Described in more detail; the head, seen from the front, is oval, the long diameter transverse; centrally is a transverse suture, the base of the labrum; above this is the clypeus, marked more by a double patch of nearly black colouring than by sutures, and the vertex (dorsal) above this; below the suture is the labrum, and lower, and on each side, two large pieces, apparently (and probably) the mandibles. The black lines of the glazed eyes margin the ellipse at each side. The whole surface (except labrum and mandibles) have a clothing of ruddy brown hairs about 0·4mm. long. The head dorsally has a faintly trefoil outline, the eye on either side projecting a little, with a hollow between it and the front of the head, which equally projects a little. The eyes are just visible, with the antennal bases behind them. The antennæ have transverse wrinkles, and these continue till those of the two antennæ nearly meet in the middle line, yet the sutures of the sides of the antennæ die out some way before this, die out rather than suddenly end. Between the antennæ, and in front of the prothorax, is a narrow strip, cut off from the rest of the head by a suture as definite as that between it and the prothorax; this is the dorsal headpiece, with longitudinal wrinkles, that continue across the suture into the front (ventral) headpiece; it, and apparently the front headpiece, has a median suture; its width is about 0·12mm. medially, 0·24mm. at outer ends. This piece occurs in skippers only, amongst the butterflies. Seen laterally, the head has a regularly curved outline. The glazed eye and the dark area it encloses make a large part of the centre. The antenna behind this has the joint between scape and flagellum in line with lower margin of glazed eye, and the scape is fairly demarcated from the rest of head, except perhaps at one point. The hairs give the glazed eye some resemblance to an eye with lashes and eyebrows. Seen ventrally, the outline of the head is the same as dorsally. The dark colour of the clypeus forms the top, the eyes have again the appearance of an eye with lashes. Centrally, are three large pieces well marked out, the labrum and mandibles, the latter separated by a narrow slip, which reaches up to the labium and extends down for about an equal distance between the maxillæ. This narrow diamond-shaped piece has no central line, and is rather the labium than the labial palpi. The prothoracic piece is about 0·5mm. from back to front, and is wider at its posterior margin, as the antenna gives it more room; at its outer posterior border is the prothoracic spiracle. Of this, the anterior margin, swollen into a smooth rounded projecting roll of nearly black colour, is alone visible and is very conspicuous, especially so as it is surrounded by a white mass of powdery material, apparently a cutaneous exudation very like that of some aphides, and perhaps with some affinities to the asbestos-like secretion of some mature

Urbicolid larvæ (*Thymelicus acteon*, etc.). This efflorescence is dense and very white round the spiracle, and varies much in different specimens as to how far and how thickly it spreads over the wing-cases, antennæ and legs. It is probably a protection against wet, as when the pupa is dipped in water, those portions with the efflorescence, and those alone, come out dry. The peculiar (mammalian) eye-like effect of the glazed eye only appears when the pupa is closely examined, but the resemblance of these spiracles to eyes is very obvious—the black lid of the spiracle (somewhat oval), the white efflorescence around, and the red hairs above it—and this effect is not much diminished when the efflorescence extends to some distance. In looking at the back of the pupa under a lens, so as to see both the head and thorax, the striæ of the dorsal headpiece, and a similar series in front of it, are very noticeable. The mesothorax is 3mm. long in the middle line, hollowed out behind at either side; its sculpturing is rather a set of separate pits than the wrinkling of the head and prothorax; on the abdominal segments the sculpturing is almost entirely pitting. The hairs arise from some of these pits, but others that look just the same are without them. The general surface is of a terracotta colouring (with underlying green), and these pits are deep red-brown, and, to the naked eye very largely modify the colouring. They look as if a wash of their colour had been given to the whole pupa, and then rubbed off except in these hollows. The metathorax is narrow in the middle, wide laterally. In colouring it is marked off from the hindwings very sharply, the outer end of the segment being deep brown-black, the wing luteous. The 1st abdominal segment is divided into two (except at the ends) by a transverse depressed line. The 2nd and 3rd, and 7th and 8th abdominals have a posterior subsegment, smoother and paler than the anterior portion, the two portions looking very similar to the segment and intersegmental membrane on the 4th, 5th and 6th abdominals, except that the posterior portion carries hairs. The sculpturing of these is small dark pits, some of which carry the brown hairs. The 4th abdominal segment requires special notice on account of its form. It is much narrower behind than in front, its anterior and posterior margins are not parallel as in the other abdominal segments, but separate ventrally, so as largely to account for the dorsal position of the remaining segments. A large part of the front of the segment is covered by the wings, but the outline of what is visible shows that it is nearly twice as wide ventrally as dorsally. The 8th, 9th and 10th abdominal segments are paler than the others and a little smoother. The others are also rather less markedly pitted ventrally than dorsally. On the dorsum, the black markings, yet to be described, differ from the rest of the surface only in colour; this is not so ventrally, certain dark markings on the 5th and 6th abdominals being smooth and free from pittings, and marked off as slightly sunk or raised. These are—on the 5th abdominal—a transverse mark rather behind middle of segment, almost, but not quite, continuous with a darker circular mark beyond its extremity that might be the scar of the prolegs, but is perhaps a little too far out. There is no transverse mark on the 6th abdominal, but the prolegs (?) marks are repeated; there is another smaller mark higher up and further out. On the small ventral portion of the 4th abdominal not covered by the wings, are three similar marks. The dark markings of the dorsum do not

appear to differ very much on different pupæ. There is a dorsal series, which, on each abdominal segment, forms a large central blotch, but becomes smaller forwards, and, on the mesothorax, is represented by spots on either side, of which there are two pairs, one about the middle and one behind, a third pair is perhaps represented by a dark hindmargin to the centre of the segment. Then there is a subdorsal line (between probable positions of ii and iii) which is a band on mesothorax, but divides into a series of spots towards the front of each segment, usually with a little line behind each. Then round the spiracles are dark blotches, a large one in front, and smaller ones, or rather spots, one above, another below, and one behind. In both sexes, the 9th abdominal segment is moderately broad dorsally, but laterally is nearly evanescent, and continues round the ventral aspect as an extremely narrow strip, and, in the male, this strip cannot be easily distinguished from the 10th abdominal segment; it carries in the male a minute impressed line, medially ventrally, with slightly raised surrounding area. A smooth area (of 10th abdominal) separates this from the similar, but much larger, anal scar. This has, in both sexes, some cross wrinkles and folds. In the female, the appearance is as if the impressed line of the 9th abdominal segment was longer, and obtained the extra length by the retreat of the 8th abdominal segment in the middle line. The cremaster itself is a dense bundle of thick hairs, so closely packed that they seem absolutely solid, and cannot be counted, 30 or 40 perhaps; a few stand out a little longer than the others; each ends in a rounded hook always facing inwards towards the centre of the bundle. It remains to note the appendages. These—legs, wings, antennæ, etc.—are of a lighter colour than the rest of the pupa, due to more delicate texture and the green tissues beneath showing through, so that they are of an olive-green, with a slight brownish tint, and, in some cases, with some snow-white efflorescence, almost always more near the wing-bases, and on the antennæ near the first spiracle. They are without any hairs, and contrast herein also with the rest of the pupa. The brown is largely made up by the darker colour in the lines and grooves of the sculpturing, which is, therefore, colouring also. Except over the broad bases of the maxillæ, where it is longitudinal and netted, the lines of colour are nearly all transverse and zebra-like, but differing on each organ, and, on the wings, modified by the venation. The maxillæ begin as broad plates, and, narrowing at first, rapidly pass down to the ends of the wings at the posterior border of the 4th abdominal. In front, where they abut against the mandibles, they are still quite ventral, but the mandibles above them are not so, but are involved in the curve of the anterior end of the pupa. The 1st and 2nd legs have each about the same margin against the eyes, so that the 1st is well separated from the antenna. The 1st reach about half-way to end of maxillæ, the 2nd more than three-fourths. The end of the antenna reaches to about midway between these two points. The antennal club is about as obvious as in the imago; the joints are strongly outlined, basally they have four or five lines (brown impressed) on each, then these get fewer till at the base of club there are two, then one, and on the club itself, none. On the wing, the veins are all well marked, in paler, hardly raised, lines - 1*b*, 1*c*, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11. The costal vein only is not seen (covered by antenna ?). There is also a medio-

cellular vein. The shading of these and of the spaces by the darker lines is very regular and beautiful. Poulton's line is very distinct. It arises somewhere about half-way along the inner margin, passes along the hind margin, terminating at vein 8, perhaps visible a little beyond this, in some specimens becoming costal. The space beyond Poulton's line is about 0·25mm. wide at anal angle, about 0·5mm. at vein 7, and (obliquely) from vein 8 to apex is about 1·0mm. The hindwing is a narrow slip, stopping rather suddenly just before the spiracle of the 3rd abdominal. The abdominal spiracles are inconspicuous, they are raised on slight cones, but only reach the general surface level as the cones arise from oval pits with vertical walls; these walls present a slender black line; the pits are, however, practically absent on the posterior segments. The following dimensions of the pupa may prove interesting :—

| | Length from front. | Transverse Diam. | Antero-posterior Diam. |
|---|---|---|---|
| Where front curves into side .. .. | 0·3mm. | 2·5mm. | 1·0mm. |
| Front of prothorax .. .. .. .. | 1·4 ,, | 2·5 ,, | 2·0 ,, |
| Back ,, (1st spiracle) .. | 1·7 ,, | 2·5 ,, | 2·5 ,, |
| Wing-spines .. .. .. .. .. | 2·0 ,, | 3·0 ,, | — |
| Highest point of mesothorax .. .. | 2·5 ,, | — | 3·0 ,, |
| Posterior margin of mesothorax .. | 4·0 ,, | 3·3 ,, | 3·0 ,, |
| ,, ,, metathorax .. | 4·4 ,, | — | 3·2 ,, |
| ,, ,, 3rd abdominal.. | 7·0 ,, | 4·0 ,, | 3·7 ,, |
| ,, ,, 4th ,, .. | 8·0 ,, | 3·2 ,, | 3·1 ,, |
| ,, ,, 5th ,, .. | 8·9 ,, | — | 2·8 ,, |
| ,, ,, 6th ,, .. | 9·7 ,, | 2·3 ,, | 2·2 ,, |
| ,, ,, 7th ,, .. | 10·5 ,, | — | 1·7 ,, |
| ,, ,, 8th ,, .. | 11·1 ,, | — | 1·0 ,, |
| ,, ,, 9th ,, .. | 11·6 ,, | 0·7 ,, | 0·6 ,, |
| ,, ,, 10th do. = total length | 12·5 ,, | — | — |

(Chapman). Length about 12mm.; thick and stumpy in outline; the eyes prominent, the wing-cases well developed; the whole skin rather rough; the middle of the head, the eyes, and the back, set with short stiff hairs; the ground colour reddish-grey, the wing-cases pinkish-grey; the abdomen tinged with brownish-red along the back; on the centre of the head, on the eyes, and on either side of the thorax above the wing-cases, are some blackish-brown marks; there are smaller marks in pairs down the middle of the thorax, and there are transverse rows of spots on the segments of the abdomen, the largest and darkest being next the wing-cases; the hairs are light brownish-red; the anterior spiracle is black, the others of the grey ground colour, ringed with black and placed within the largest dark blotches (Hellins).

Time of appearance.—This species, in the British Isles, is single-brooded, occurring in May and June, but may appear a little earlier or later, according to the season. In the lowlands of Central Europe it is generally reputed as double-brooded, but a study of certain critical remarks on this subject leads one to suppose that, at the most, the species is, like all those that feed up fairly rapidly in the summer, and pupate as soon as fullfed, only partially double-brooded, a few (or many) imagines appearing, in peculiarly suitable seasons, as a second brood, their progeny having to reach the pupal stage before winter is on them. Occasional late individuals may represent this

brood in Britain, but even such late captures as July 16th, 1902, at Chattenden (Burrows), and August 2nd, 1902, at Thundersley (Whittle), were, in such a backward year as 1902, possibly only late emergences from winter pupæ. The effect of latitude and altitude is very remarkable, for, at moderate elevations, 3500ft.-5000ft. in Aragon, Cantabria, the Italian, Swiss and French alps, as well as in the Cevennes, the Pyrenees, and the Tyrol, the end of June, July, and early August, are frequent dates, whilst, on the Riviera, and the warm lowland spots of the Mediterranean littoral, the earliest imagines are to be seen on the wing by the middle of March. Some general notes may be interesting as illustrating this, *e.g.*, it occurs from early May (in the Christiania district), to July (at Siredal) and August (at Ose) in Norway (Strand); throughout the lowlands in Switzerland, from the end of April to the end of May and later, but, in the mountains, until quite late in July (Frey); in the neighbourhood of Geneva, from the beginning of May to the end of June (Blachier); in the Balkans also, it occurs at rather high elevations well into July (Rebel), and, in Sicily, although out in early April in the warm lowlying parts, it occurs in July on the Madonie Mountains at considerable elevation (4500ft.) (Palumbo); in April, at Florence (Rowland-Brown). Dupont notes it as occurring as early as April 6th, in 1893 (compare British dates for this year), but not seen until the commencement of June, in 1902, at Pont de l'Arche, and, in the latter year, Moore says that it abounded, in the neighbourhood of the Forêt d'Arques, from June 26th-30th, 1902; in Ille-et-Vilaine, it occurs in May, but at Chamonix, in June and July, at Uriage in June, on the Mont Revard in July, at Cauterets also in July, at St. Martin Vésubie in June, but at Vernet-les-Bains, in April, May, June, July and August (Oberthür) (Standen took it at Vernet between June 17th-27th, 1905); whilst at Digne it occurs in early April, and, along the French Riviera—Hyères, Auribeau, etc.—the earliest examples are on the wing before the end of March (Tutt). In the Russian Government Wolgoda, it is common in June (Kroulikowsky); at Broussa, it occurs in April and early May (Fountaine); and in May and June on the Lebanon Mountains (Nicholl); in Crete, it occurs in June (Mathew); June is also recorded for Alsasua, in Spain (Oberthür); June is given for the Albarracin district (Zapater and Korb); whilst at the Puerto de Pajares, at a height of 4500ft., on the Cantabrian Mountains, it was well out between July 3rd-22nd, 1904 (Chapman), and high in the mountains of Aragon, a small form occurred about mid-July (Nicholl); whilst, even at Montserrat, June 16th, 1905, was the date on which it was taken (Standen). On the Stelvio, it was observed in mid-July (Rowland-Brown). Double-broodedness is recorded—for Roumania, in May and September (Fleck); the Italian Apennines, near Boscolungo, in April and August (Norris); the dept. of Indre, May 20th-26th, and August 5th-October 3rd (Martin); May and again July-August in Prussia (Schmidt); May-June and August, commonly in Pomerania (Paul and Plötz); May and June in Hamburg, and then September (Tessien); May and July at Göttingen (Jordan); April-May and July-August at Crefeld (Rothke); May and August in Hesse-Nassau (Schenck); May and July in Frankfort-on-Main (Koch); May-June and July-August in the Berlin district (Bartel); April-June and August in Upper Lusatia (Möschler); in the lowlands of Silesia in May and August, in the mountains only in June (Wocke); May and July-August at Chemnitz (Pabst); May, June and August in Bavaria (Hofmann and Herrich-Schäffer); May-June and August in Württem-

berg (Keller and Hoffmann). [Rondou notes that, in the Pyrenees, it occurs from April to September, but Rondou appears to be mixing up *Erynnis malvarum* with this species.] CONTINENTAL RECORDS.—July 23rd, 1850, on the Patscher Kofel, a ♀ in fine condition (Speyer); May 14th, 1865, in the Riedt, near Wallisellen (Dietrich); June 15th, 1886, at Andermatt, abundant (Jones); June 14th-16th, 1890, at Tancarville (Leech); June 1st, 1892, at the Certosa di Pesio (Norris); April 6th, 1893 (as late as commencement of June, 1902), at Pont de l'Arche (Dupont); early June, 1893, from sea-coast to 2500ft. elevation, in Corsica (Standen); August 12th, 1894, at Cogne (Tutt); July 3rd, 1895, at Martigny (Blachier); March 24th-April 6th, 1897, in the Cannes district (Chapman); April 6th-21st, 1897, at Veytaux (Wheeler); April 13th-29th, 1897, at Digne (Tutt); August 6th-27th, 1897, at Bérisal (Wheeler); May 5th, 1897, at Aix-les-Bains (Chapman); March 25th-April 15th, 1898, in the Cannes district; April 21st, 1898, at the Pont du Gard (Tutt); June 20th-July 9th, 1898, at Saeterstoen (Chapman); between June 21st, 1899, and end of month, at Susa (Rowland-Brown); May 27th, 1899, at Veytaux (Wheeler); May 21st, 1899, near Sophia, May 23rd, near Slivno, June 26th, in the Rilska Valley (Nicholl); May 12th-June 16th, 1900, abundant at Orta and in neighbourhood (Lowe); April 22nd, 1900, at Argostoli, in Cephalonia (Fletcher); May 29th, 1900, at the foot of the Petit Moeuveran, at a point unusually high for this species (Wheeler); one in August, 1900, at Rennes (Oberthür); May 3rd-6th, 1901, at Larkollen, May 14th-17th, 1901, at Vallo (Strand); June 20th-25th, 1901, at Bozen, S. Tirol (Lowe); June 23rd-24th, 1901, on Mont Sény (Nicholl); from July 16th-August 5th, 1901, in the Cevennes (Brown); throughout May and early June, 1901, in the Lebanons (Fountaine); May 26th-June 6th, 1902, between Montreux and Aigle (Barraud); May 15th-17th, 1902, at Fredrikstad, May 17th-June 7th, at Hvalöerne, June 26th-July 17th, 1902, at Sireosen (Strand); April 6th, 1902, at Digne (Rowland-Brown); April 25th, 1902, in the Seine-Inférieure (Smallman); June 26th-July 1st, 1902, at St. Georges, in the Jura (Wheeler); June 26th-30th, 1902, near the Forêt d'Arques (Moore); July 1st, 1902, at the Riffel Alp (Sheldon); July 12th, 1902, at Koinsko Polie, at 600m. (Sturany); March 30th, 1903, at Hyères, April 6th-11th, at Auribeau, April 13th, at Alassio, April 19th, 1903, at Locarno (Tutt); June 19th-23rd, 1903, at Macolin (Lowe); July 6th, 1903, at Ubli (Hilf); July 20th, 1903, at Saas-Fée (Blachier); June 26th-July 1st, 1903, at St. Georges, April 20th, 1904, at Aigle (Sloper); May 31st, 1904, at Neiderneundorf (Dadd); July 3rd-22nd, 1904, at Puerto de Pajares (Chapman); April 24th-30th, 1905, at Hyères and the Plan du Pont, May 5th-8th, 1905, at Draguignan (Tutt); June 16th, 1905, at Montserrat, June 17th-27th, 1905, at Vernet-les-Bains (Standen); July 26th-August 11th, 1905, at Vernet-les-Bains (Oberthür); May 1st-June 6th, 1905, round Geneva; in same locality still quite fresh on September 8th, two specimens of ab. *fasciata* (a partial second brood ?) (Muschamp); May 30th, 1905, at Niha (Graves); June 15th, 1905, at Gex, July 11th, 1905, at Simplon (Blachier). BRITISH RECORDS*.—Late May and

* The following dates were received after the rest were set up:—May 16th, 1857, June 25th, 1858, at Southampton (Swinton); May 8th, 1868, at Steyning

beginning of June, at Legsby Wood, Market Rasen (Court); May 15th-27th, 1857, at Poynings (Image); May 20th, 1871, at Sevenoaks, May 29th, 1871, at Tunbridge Wells (Raynor); May 1st-June 15th, 1871, at Wanstead (Burrows); June 15th, 1872, at Brentwood, May 30th, 1873, at Monk's Wood, June 14th, 1873, at Woodham Ferris (Raynor); June 8th, 1873, in Coombe Wood (Whittle); common at Willesden, previous to 1875 (Sharp); May 23rd, 1875, at Wimbledon, June 26th, 1875, in Blean Woods, May 7th, 1876, at Wimbledon, May 21st, 1876, at West Wickham, May 28th and June 9th, 1876, in Blean Woods, near Herne, June 17th, 1877, and May 5th, 1878, in Epping Forest (Whittle); May 7th, 1882, May 8th, 1883, at Reading (Butler); June 5th, 1883, at Pembroke (Barrett); June 4th, 1883, at Newstead Park (Wright); May 28th-31st, 1884, in the New Forest, June 19th, 1884, in the Isle of Wight (Bankes); May 9th, 1885, at Reading (Butler); May 27th, 1885, May 23rd, 1886, at Brentwood (Burrows); June 1st-2nd, 1886, at Glanvilles Wootton (Bankes); June 13th, 1886, at Reigate, June 4th, 1887, at Greenhithe (Whittle); May 13th, 1888, at Reading (Butler); May 21st, 1888, near Gomshall (Whittle); May 17th, 1889, at Brentwood (Burrows); May 22nd-24th, 1889, at Bloxworth (Bankes); May, 1890, in the New Forest (Hewett); May 4th, 1890, in Epping Forest (Bayne); May 16th, 1890, at Brentwood, May 24th, 1890, at Lockerley (Burrows); May 18th, 1890, at Benfleet (Whittle); May 19th, 1890, at Brentwood (Raynor); May 26th, 1890, at Snodland (Tyrer); end of May, and beginning of June, 1890, at West Malvern (Dobrée-Fox); June 28th-July 17th, 1890, at Brockenhurst (Blagg); May 13th, 1891, in the New Forest (Bankes); May 31st, 1891, at Reading (Butler); common from May 30th, 1891, at Brockenhurst (James); June 1st-15th, 1891, at Great Leigh (Burrows); first appearance for year, on April 23rd, 1892, at Tring (Elliman); May 11th, 1892, near Leigh (Whittle); May 23rd-25th, 1892, in the Isle of Purbeck, May 30th, 1892, at Bloxworth (Bankes); June 2nd-12th, 1892, in Abbott's Wood, and at Hailsham (Tugwell); June 5th, 1892, at Castle Ryan (Gordon); June 16th-26th, 1892, at Folkestone (James); April 7th, 1893, near Hereford (Blathwayt); April 9th, 1893, at Eynsford (Carpenter); April 10th, 1893, at Stroud (Davis); April 14th, 1893, at Tonbridge (Turner); April 14th-May 6th, 1893, in Epping Forest (Hunt); April 16th, 1893, at Instow (Hinchliff); April 17th, 1893, at Worcester Park (Kaye); April 18th, 1893, at Southend (Battley); April 18th, 1893, in the Wye Valley (Nesbitt); April 20th, 1893, in

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(White); May 14th, 1868, at Cirencester (Harman); June 5th-26th, 1869, at Brockenhurst (Capper); May 16th, 1875, at Marlow (A. H. Clarke); June 28th, 1877, in Chattenden Wood, May 12th, 1878, at Chislehurst, May 30th, 1881, at Box Hill, May 11th, 1882, fourteen at Box Hill, May 17th, 1883, common at Box Hill, May 7th, 1886, at Box Hill (Bower); June 4th, 1887, at Cuxton (Tutt); June 13th, 1887, at Greenhithe, May 23rd, 1888, at Chislehurst, June 9th, 1891, at Esher, May 9th, 1892, common at Box Hill, April 18th, 1893, at Box Hill (Bower); April 30th, 1893, at Marlow (A. H. Clarke); April 12th, 1894, at Box Hill, May 4th, 1895, at Farningham, May 14th, 1895, at Bexley (Bower); earliest date noted at Ashford, May 4th, 1895 (Wood); May 15th, 1896, at Lee (Bower); May 16th, 1897, at Marlow (A. H. Clarke); June 11th, 1897, at Box Hill, May 17th, 1898, at Box Hill, June 7th, 1898, at Oxton (Bower); June 4th, 1899, at Marlow, May 20th, 1900, at Marlow (A. H. Clarke); June 4th, 1900, at Darenth Wood, May 21st, 1901, at Shoreham (Bower); May 25th, 1901, at Marlow (A. H. Clarke); May 22nd, 1903, a few at Shoreham, May 20th, 1904, at Darenth Wood (Bower); June, 1904, at Carmarthen (Barker).

the New Forest (Beeching); April 20th, 1893, at Colchester (Harwood); April 22nd, 1893, in Pembroke (Jefferys); April 29th, 1893, near Hatfield (Waldegrave); April 29th, 1893, in Chattenden (Tutt); April 29th, 1893, in Epping Forest (Freer); May 6th, 1893, in thousands, in the meadows around Pinner Woods (Rowland-Brown); May 10th, 1893, at Pinner (South); May 16th-27th, 1893, at Bloxworth (Bankes); May 13th, 1893, at Horsley, June 10th, 1893, at Oxshott (Turner); May 23rd, 1893, at Brentwood, May 17th, 1894, at Benfleet (Burrows); April 20th, 1894, at Bath (Greer); May 8th-28th, 1894, at Benfleet (Whittle); May 24th, 1894, at Guildford (Grover); June 8th-17th, 1894, at Brockenhurst (Wells); scarce in April and May, 1895, at Oxton (Studd); May, 1895, at Cheltenham (Robertson); May 30th, 1895, at West Norwood (T. Fletcher); June 3rd, 1895, May 13th, 1896, at Reading (Butler); April 17th, 1896, at Oxton (Studd); well out at the end of April, 1896, was most abundant the first fortnight in May, on June 20th, a freshly emerged specimen at Chattenden, and a worn one on June 28th, at Cuxton (Tutt); rather scarce, first seen on May 11th, 1896, in the Guildford district (Grover); May 18th, 1896, at Church Stretton (Newnham); May 22nd, 1896, in the New Forest, June 30th, 1896, at Oxshott (Tremayne); May 23rd, 1896, in Epping Forest (Simes); July 6th, 1896, at Cairn Ryan (Gordon); May 16th, 1897, at Reading (Butler); May 17th, 1897, in the Guildford district (Grover); May 17th-21st, 1897, at Balcombe (Image); May 22nd, 1897, at Hazeleigh (Raynor); May 15th, 1898, at Benfleet, May 22nd-June 19th, 1898, at Eastwood (Whittle); May 24th, 1898, at Hazeleigh (Raynor); June 11th, 1898, at Reigate (Adkin); May 9th-14th, 1898, at Balcombe, July 1st, 1898, at Theydon Bois (Image); July 2nd, 1898, at Appledore (Heitland); July 2nd, 1898, on Stanmore Common (Barraud); May 11th, 1899, at Hazeleigh (Raynor); May 13th and June 4th, 1899, at Eastwood (Whittle); May 19th-22nd, 1899, in the New Forest (Prout); May 29th, 1899, at Stroud (Davis); May 31st, 1899, in Monk's Wood, June 10th-11th, 1899, at Shoreham, Kent (Carr); end of May, 1899, at Westwell (J. E. Gardner); June, 1899, four specimens in a wood between Penn and High Wycombe (Swain); June 4th, 1899, at Reading (Butler); June 1st, 1899, at Mill Hill (James); June 5th, 1899, in the Frensham district (Newland); May 17th, 1900, at Hazeleigh (Raynor); May 19th, 1900, at Epping Forest, June 3rd, 1900, at Westwell (J. E. Gardner); June 4th, 5th, and 6th, 1900, at Newbury (Hopson); May 20th, 1900, at Reading (Butler); June 4th, 1900, in the Guildford district (Pickett); June 4th, 1900, on Aldbury Down, June 9th, 1900, at Eynsford (Barraud); June 27th, 1900, a very large dark ♀ at Ashton Wold (Rothschild); June 10th, 1900, at Beachy Head (Blenkarn); June 10th, 1900, at Eastwood (Whittle); June 14th, 1900, at Oxshott (Lucas); May 10th, 1901, just making its appearance at Box Hill (Croker); May 11th, 1901, at Hazeleigh (Raynor); May 18th, 1901, in Epping Forest, June 9th, 1901, at West Wickham (J. E. Gardner); May 15th and 25th, 1901, common in West Sussex (J. F. Bird); May 24th-27th, 1901, at Breidden Hill (Tetley); May 12th, 1901, at Reading (Butler); May 23rd, 1901, in the New Forest (Robertson); May 25th, 1901, on Aldbury Down, May 27th, 1901, at Bushey Heath, same date at Bricket Wood (Barraud); May 24th-29th, 1901, near Burgess Hill (Dollman); June 7th-10th, 1901, at Balcombe (Image); June 10th, 1901, in the Isle of Purbeck (Bankes); May 11th and 23rd, 1902, at Tring (Barraud);

May 19th, 1902, at Reading (Butler); May 24th, 1902, at Hazeleigh (Raynor); May 27th, 1902, at Breidden Hill (Tetley); May 24th-June 18th, 1902, at Dorking (Oldaker); June 7th and 11th, 1902, in Epping Forest (J. E. Gardner); June 15th, 1902, at Hailsham (Browne); June 18th-July 1st, 1902, in the New Forest (Lofthouse); June 22nd and 26th, and August 2nd, 1902, at Thundersley (Whittle); June 27th, 1902, on Stanmore Common (Barraud); June 8th, 1902, in West Sussex (J. F. Bird); as late as June 21st, 1902, in poor condition, at Oxhey Lane (Rowland-Brown); June 5th, 10th, and July 16th, 1902, at Chattenden (Burrows); May, 1903, at Brockenhurst, June 6th, 1903, on Stanmore Common (Barraud); May 19th, 1903, at Hazeleigh (Raynor); May 28th-June 11th, 1903, in the Isle of Purbeck (Bankes); June 10th-12th, 1903, at Taunton (Tetley); May 29th, 1903, in the New Forest (J. E. Gardner); May 13th, 1903, at Reading (Butler); May 21st, 1903, at Oxhey Lane (Rowland-Brown); June 23rd, 1903, at Chattenden (Burrows); April 25th-May 25th, 1904, in the Isle of Purbeck, June 17th, 1904, at Blandford (Bankes); May 25th, 1904, at Hazeleigh (Raynor); May, 1904, at Brockenhurst (Barraud); June 5th-13th, 1904, at Thorndon (Whittle); June 9th, 1904, at Brentwood (Burrows); May 23rd-June 3rd, 1904, at Taunton (Tetley); May 18th, 1904, at Dorking (Oldaker); June 8th, 1904, at Brentwood (J. E. Gardner); May 7th, 1904, at Reading (Butler); May 9th, 1905, at Hazeleigh (Raynor); not so scarce as in 1904, first seen May 20th, 1905, at Tintern and Llandogo, one specimen, taken on May, 23rd very near ab. *taras* (J. F. Bird); June 13th, 1905, in the Isle of Purbeck (Bankes); May 22nd, 1905, at Loughton (Image); May 7th, 1905, at Reading (Butler); occasionally between Princes Risborough and Wendover, April to May, and as late as June 3rd, 1905 (Rowland-Brown); May 27th, 1905, in Epping Forest (J. E. Gardner); June 15th, 1905, at Chattenden (Burrows); May 21st, 25th, and June, 1905, at Carmarthen (Barker); June 21st, 1905, latest date noted at Ashford (Wood); July 16th, 1905, at Shepton Mallet (Bogue); April 25th, 1906, first example of the year seen at Tintern, at rest on a blossom of wild hyacinth (J. F. Bird).

Habits.—The butterfly is very active, flying swiftly from one spot to another in the sunshine, resting on leaves, and more often on flowers, and frequently on bare patches on the ground. When at rest in the sunshine it lowers its wings, sidling round so that the sun falls directly on its almost fully expanded wings. When, however, the weather is dull, or it has settled for the night, it draws its wings over its back, lowers the forewings until all but the tips are hidden by the hindwings, and, folding them closely to its abdomen, the tints of its underside hide it very effectively. It often sleeps on grass-stems at Marlow (Clarke). Gillmer says: "According to my experience, this butterfly is a very fugitive creature, and very hard to follow with the eye when in flight. In the localities of the Mosigkauer Haide (Dessau) where it flies, it rests readily on blossoms and dry portions of plants, seldom on the ground, and opens the wings fully, or to two-thirds, in the sunshine. The ♂ is commoner here than the ♀, the former appears also somewhat earlier than the latter." Schilde (*Berl. Entom. Zeitschr.*, xxx., p. 55) remarks, however, that "the movements of *H. malvae* in nature are by no means rambling, but it remains rather a long time in one spot. If the sun shines, it spreads the wings widely, and when it rests in this position on the end of a dry, last year's flower-head, or

even on a green one of the same year, it appears then to be protected by mimicry. It imitates the little heads of the plants of *Plantago lanceolata* which are blooming around it. It rests, equally well-protected also, in dull weather, when it sits, with its wings carefully folded together, on a tuft of heather, or on the pale-coloured remains of the previous year's flower-heads in the grassy woodland roads, and the coloration of the underside of the wings is in sympathy with these resting-spots." Bird also notes (*in litt.*) that, in Sussex, when settling down for the night, he also observed that the species was especially fond of choosing the old seed-heads of *Plantago lanceolata* on which to rest, the spotted markings on the underside of the butterfly giving to the withered spike a remarkable likeness to the fresh inflorescence of the plant. Chapman, observing the species at Ste. Maxime-sur-Mer, notes (*in litt.*): "*H. malvae* is very difficult to follow with the eye when on the wing, especially if it be at all alarmed. It does not return to a particular spot with much frequency, and, if at all alarmed, it need not be expected there again. It flies very straight forward, but, before alighting, often makes a little circle. It frequents paths and roads, especially in or near a wood, and will often alight on the middle of the path, its habits, in this respect, being very similar to those of *Melitaea cinxia*. When it settles it at once orients itself, tail to the sun, and sits quietly, with its wings slightly raised, so as to form a cup or valley to catch the sunshine. It flies rather close to the ground, but not so closely as *M. cinxia* does when flying along a road. The latter, however, rests just like *H. malvae*, tail to the sun, and wings slightly raised." Blachier observes that, in the neighbourhood of Geneva, it settles freely, in numbers, on the damp spots in roadways, etc., and remains a long time in the same place, in company with other Hesperiids, *e.g.*, *Hesperia alveus*, *H. serratulae*, *Powellia sao*, and Lycænids, *e.g.*, *Cupido minima*, *C. sebrus*, *Polyommatus icarus*, *Nomiades cyllarus*, and *N. semiargus*.

Habitat.—The species is not particular in its choice of habitat, frequenting rough open places in, and the ridings of, woods, commons, banks, meadows, and even marshland and fens, where brambles grow freely. Wilkes says that it frequents woods and meadows; Lewin mentions the dry parts of woods and heaths; Haworth, pastures; Curtis, meadows, commons and woods; to which Stephens adds that it occurs in the fens of Cambridge plentifully. Mathew says that it frequents a marshy piece of ground on a hillside near Instow; Clifford, marshy places at Wimbledon; and Sheldon, a marsh near Vernayaz; but the woodlands are its chief haunts—the ridings of woods and adjacent lanes at Silchester (Rothschild); a clearing by the edge of a beech-wood, between Penn and High Wycombe (Swain); common in woods in East Sussex (Jenner); occurs chiefly on rough pastures, on the outskirts of woods, in Hunts and Essex, and when disturbed sometimes disapppears over the woods, being, in this respect, similar to *Cyclopides palaemon*, but unlike *Nisoniades tages*, which never seems to leave the level meadows (Raynor); common in the upland woods of the Cotswolds, rarely occurring in the vales (Watkins); frequenting open grassy places in the woodlands of the Cotswolds (Davis); generally common on railway-banks and cuttings, also on hills, and in woods, at Hereford (Bowell); on sloping banks near the sea beyond Castle Ryan (Gordon); in a grassy hollow near Bude, an uncultivated field at Drayton Beauchamp,

and among the heather near Farnborough (Rothschild). Rowland-Brown found it in woods at Susa, and we have ourselves taken it in the earliest spring in the lush meadows at Auribeau, on the cistus- and thyme-clad slopes at Carqueiranne, the rough grassy openings in the arbutus-woods behind the castle at Hyères, the grassy garden-paths at Draguignan, and breaks in the bush-covered slopes of Nismes and Digne, during the last few days of March, and on through April. In Switzerland, it occurs all through the lowlands, but goes up the valleys, in some places commonly, to 6000ft., whilst it is met with singly up to 7000ft. (Frey). In Bosnia and Hercegovina it appears to be common up to about 5000ft. elevation (Rebel), and also in the Rilo mountains, in Bulgaria (Nicholl). Although abundant in the plains, it reaches an elevation of about 4500ft. in the Madonie mountains of Sicily (Palumbo), and, in Tuscany, it occurs throughout the plains, hills and mountains (Stefanelli). At Pont de l' Arche it prefers the forest region (Dupont), and, in the neighbourhood of the Forêt d'Arques, near Dieppe, it swarmed on the hillsides in late June (26th-30th), and was also abundant in the ridings of the forest (Moore). In the Albarracin district of Spain, it occurs in the dingles and ravines of Losilla, in the gardens of Moscardon, and by roadsides, and in the lanes of the valley of Masegar (Zapater and Korb). Nearness to rivers is noted by several authors—the banks of the Wiese in Alsace (Peyerimhoff), the right bank of the Meuse (Sibille). We note that in Hesse, *H. malvae* flies in spring and summer, generally on rather bare places, roads, or rubbish heaps, also in hot sunshine on damp paths, most commonly, however, on bare thistle-covered slopes (Glaser). In Waldeck, in sunny openings in woods, pastures, roads, etc., common from April (1862, as early as the 10th), or beginning of May, till mid-June (Speyer). In Denmark it is common in openings in woods and on peat moors, in fields and pastures; in May and beginning of June, only one brood (Bang-Haas). In Esthonia, in May, in damp meadows and bushy places, and on the moors (Peters). In Kurland, only in dry places (Slevogt). In Livonia, from beginning of May into June, in scattered woodlands, in meadows, and in grassy spots in woods, sunning itself low in the grass, but very shy (Nolcken). In Pomerania, it prefers grassy places (Hering); open spots in woods in Mecklenburg, where it is often abundant (Schmidt); near Friedland it is common on pastures and in copses (Stange); whilst it prefers woods and sandy slopes in Schleswig-Holstein (Boie); at Bremen, it prefers woody slopes (Rehberg); and in Hanover, woodlands are favoured (Glitz); although at Elberfeld and Crefeld it prefers flowery meadows; it is also abundant throughout the Rhine Provinces on the embankments of the Rhine, and its tributary streams, as well as in the adjacent meadows (Rothke); at Wiesbaden it prefers wooded districts (Rössler); as is also the case at Cassel (Borgmann); in Thuringia, it goes up into the valleys of the higher mountains, being sometimes abundant in the forest clearings (Krieghoff); whilst in the kingdom of Saxony it also goes up into the mountain-meadows (Speyer); in Silesia, it extends from the wood-clearings, thickets and marshes of the lowlands, up to the high mountain valleys, etc. (Wocke). In the province of Saxony it prefers flowery meadows near woods, and the woodland paths of the Mosigkauer Haide, and is common in May and June, whilst a second, but much less abundant brood, flies in the same

places in August (Gillmer). In Austria also it occurs everywhere in the meadows of Bohemia and Moravia, whilst in Lower Austria, it abounds in the plains, and extends up the mountains into the high alpine meadows at Hocheck (Fritsch); similarly, in Salzburg, it extends from the plains even above the region of alpine meadows, occurring in the lowlands almost everywhere—in warm meadows, in clearings on the outskirts of woods, in the rich flowery meadows, being especially abundant on the Schallmoose near Salzburg (Richter). In the Tyrol, it extends from the plains to the upper alpine region at 7000ft. (Hinterwaldner), and at Innsbrück, from the level of the town to the region of the alpine pastures on the surrounding mountains (Weiler). We ourselves found it at an elevation of above 6000ft. at Cogne, in the Graian Alps, and Chapman on the railway embankments at Saeterstoen in Scandinavia. These habitats, when compared with the lovely slopes above Lake Maggiore and our own home woodland drives in Chattenden, offer sufficient variety in the habitat of a most interesting little species.

British localities.—Throughout England and Wales, but exceedingly local and rare in Ireland and Scotland. Bedford: Bedford—Luton, Potton (Vict. Count. Hist.), Twin Woods, Clapham (Nash). Berks: near Wokingham (Hamm), Newbury (Hopson), common at Boar's Hill and Bagley Wood (Geldart), Radley (Burr), Reading, common (Butler). Bucks: Halton, Wavendon, near Newport Pagnel (Stainton), Wendover district (Brown), between Penn and High Wycombe (Swain), formerly at Drayton Beauchamp (Rothschild), Chalfont, St. Peter (St. John), Marlow (Clarke). Cambridge: fen districts, abundant (Jenyns), Chippenham Fen (Rothschild), Cambridge (Waters), Ely (Archer), Boxworth (Thornhill). Carmarthen: Pendine, Oaklands (Barker). Cornwall: Truro (Rollason), near Bude (Rothschild). Denbigh: Cefn Caves, near Ruthin (Gardner). [Derbyshire: Bakewell (Payne), *in error* (Fuller).] Devon: plentiful in south Devon (Rogers), Exeter, Plymouth, Teignmouth (Stainton), Sidmouth (Majendie), Instow (Hinchliff), Oxton (Studd), Torquay (Crocker), Lustleigh (Buckell), Dartmoor (Gummer), near Honiton, local, but where it occurs fairly abundant (Riding), Torrington, Barnstaple (Mathew), Lynmouth (Briggs), Silverton (Ward), Belstone, near Okehampton, at 900 feet (de la Garde), Paignton district (Goodale). Dorset: Portland, scarce (Partridge), Lulworth (Dale), Sherborne (Kimber), Wimborne, Hod Hill (Fowler), Glanvilles Wootton, Blandford, Bloxworth, Isle of Purbeck (Bankes), Upwey, Chalbury Vale, Culliford (Bogue). Essex: Hartley Wood (Jermyn), Epping Forest (Bayne), Colchester district — Chelmsford (Harwood), Southend (Battley), Brentwood, Woodham Ferris, Hazeleigh (Raynor), Theydon Bois, Loughton (Image), Thorndon, Thundersley, Benfleet, Eastwood, Leigh (Whittle), Wanstead (Burrows), Wood Street (Smith), Great Leigh (Burrows), Dovercourt district, rare (Mathew), Ongar Park Woods (Wright). Gloucester: Cirencester (Harman), Bristol district, generally distributed and common, Leigh, etc. (Hudd), Cheltenham (Robertson), Gloucester (Merrin), Lower Guiting (Stainton), Stroud (Davis), Painswick district (Watkins). Hants: fairly common—Southampton (Swinton), Isle of Wight, New Forest (Bankes), Brockenhurst (Hodson), Crabbe Wood, Ampfield (Hewett), New Forest—Lyndhurst (Hill), Ringwood, common (Fowler), Shedfield (Pearce), near Farnborough, near Silchester (Rothschild), Purbrook Common, Stakes Wood (Pearce), Lockerley (Burrows). Hereford: Tarrington (Wood), Leominster (Hutchinson), Hereford (Bowell). Herts: Hemel Hempstead (Piffard), Sandridge (Griffith), Haileybury (Bowyer), East Barnet (Gillum), Watford (Spencer), Aldbury, Ivinghoe (Rothschild), Broxbourne Woods (Boyd), Oxhey (Rowland-Brown), Tring (Elliman), near Hatfield (Waldegrave), Hertford, Bengeo, Brickendon (Stephens), Bricket Wood (Perkins), Knebworth (Griffith), Bushey Heath, Aldbury Down (Barraud). Hunts: common—St. Ives (Norris), Monk's Wood (Carr). Kent: Chislehurst, Lee, Farningham (Bower), Darenth Wood (Stephens), Bexley (Fenn), Chatham district (Walker), Snodland (Tyrer), Fork Common, Sevenoaks (Raynor), Ashford, common (Wood), Cuxton, Chattenden, Strood, etc. (Tutt), Eynsford (Carpenter), Appledore, Folkestone (Heitland), Longfield, near Gravesend (Jennings), Westwell (Gardner), Shoreham (Carr), Pembury, near

Tunbridge Wells, Tenterden (Stainton), Maidstone district (Golding), Greenhithe, Blean Woods, West Wickham (Whittle), Herne Bay (Battley). KERRY: Killarney (Salvage). LANARK: Glasgow (Gray). LANCS: Silverdale (Melvill). LEICESTER: Sixhills (Rowley), Gumley (Matthews). LINCS: Legsby Wood, Market Rasen (Court). MIDDLESEX: Mill Hill (James), Harrow district (Melvill), Kingsbury, Old Oak Common, foot of Hampstead Heath, Hendon, Dolton Hill (Godwin), Stanmore (Bond), Harrow Weald, common (Rhoades-Smith), Enfield (Sykes), Northwood (Sich), Pinner (South), Oxhey Lane (Rowland-Brown), Willesden (Sharp), MONMOUTH: Wye Valley (Nesbitt), Tintern, Llandogo (J. F. Bird), Monmouth (Palmer). MONTGOMERY: Breidden Hill, near Welshpool (Tetley). NORFOLK: scarce and local—Woodton, Tyndall Wood, Ditchingham, Ketteringham, Horning (Vict. Count. Hist.). NORTHAMPTON: Peterborough (Stainton), Ashton Wold, Oundle (Rothschild), Northampton (Hensman). NOTTS: Newstead Park, near Mansfield (Wright). NORTHUMBERLAND: Newcastle (Wailes). OXFORD: Oxford (Stainton), Cowley, Dorchester (Shipp), Chinnor (Spiller). PEMBROKE: Castlemartin (Puckridge), Pembroke (Jeffreys). SHROPSHIRE: Church Stretton (Newnham), Hopton Wagers (Boxer), Shrewsbury (Stainton). SOMERSET: Shepton Mallet (Bogue), Bath (Greer), Castle Cary (Macmillan), Taunton (Tetley). STAFFORD: Betton Moss (Woodforde). SUFFOLK: somewhat common (Bloomfield), Ipswich (Last), Stowmarket (Stainton). SURREY: Box Hill, Esher (Bower), Horsley, Oxshott (Turner), Woking (S. G. C. Russell), Guildford (Grover), Frensham (Newland), Dorking, Ranmore, Polesden (Oldaker), Worcester Park (Kaye), Dormans Park (Burr), Coombe Wood, Reigate, Wimbledon, Gomshall (Whittle), Croydon (Hall), Oxted (Sheldon), Riddlesdown, Shirley, Worm's Heath, Holmwood, West Norwood (T. Fletcher). SUSSEX: Abbott's Wood (Clark), Horsham (Jackson), near Burgess Hill (Dollman), Frant (Cox), east Sussex, common, Battle (Jenner), Hastings, St. Leonard's (Bloomfield), Cissbury (W. H. B. Fletcher), Worthing, Lewes (Stainton), Brighton (Adkin), Poynings, Balcombe (Image), Shipley, Cowfold, West Grinstead, Coolham (Bird), Tilgate (Sheldon), Steyning (White). WARWICK: common — Coventry (Kenrick), Hampton-in-Arden (Wynn), Knowle (Ellis), Corley Woods (Bree), Rugby, Brandon (Rugby lists), Atherstone (Baker), Ettington (Keighley-Peach), Wolford (Wheeler). WESTMORLAND: Witherslack (Arkle *Ent.*, xxi., p. 316). WIGTOWN: Cairn Ryan (Gordon). WILTS: Corsham (Stainton), Salisbury (Carr), Collingbourne Wood (Rudd). WORCESTER: Malvern (Dobrée-Fox), Worcester, common (Fletcher). YORKS: near York (Hewitson), Bramham Park (Oates), Ledstone (Smethurst), Pontefract (Hartley), Roche Abbey (W. H. Smith), Selby (Hebson), Sheffield (Doncaster), Wakefield (Talbot), near York (Prest).

DISTRIBUTION.—Europe, Asia Minor, Armenia, Altai, Ala Tau, Thian-Shan, Issy Kul district, Fergana, Mongolia, eastern Siberia, Amurland (Staudinger), also in Mauretania (Oberthür). AFRICA: Algeria—Lambèze (Oberthür). ASIA: Amurland (Elwes), Altai—the Talysch (Ménétriés), Kouldja district (Oberthür), Persia—Irak district (Young), Bokhara—Mountains Sud l'Olguine—Chemin de Taldyk, 9000ft. (Romanoff). ASIA MINOR: Brussa (Fountaine), Amasia, Tokat, Cyprus (Speyer), Syria—Akbés (Oberthür), Zebedani, Niha (Graves), the Lebanon district (Nicholl), the Taurus (Nordmann). AUSTRO-HUNGARY: everywhere (Höfner), Bohemia, common—Karlsbad (Hüttner), Senftenberg, Prague (Fritsch), Moravia — Brünn, etc. (Schneider), Kremsier, Neutitschein, Rottalowitz, Troppau (Fritsch), Upper Austria—Steyer, Enns district, Wels (Brittinger), Linz (Fritsch), Lower Austria—Vienna district (Rossi), Hernstein, common up to Hocheck (Rogenhofer), Gresten (Fritsch), Tyrol, up to 7000ft. (Hinterwaldner)—Bozen (Lowe), the Stelvio, near Trafoi (Smallman), the Patscher-Kofel, at 6900ft. (Speyer), on the Glockner, Trient (Mann), Innsbruck, Tauferthal (Weiler), Schlücken-Alp, Zirler-Mähder, Jaufen, Seiser-Alp, Monte Lobbia, Monte Piano, Franzenshöhe (Heller), Salzburg—Ischl (Hormuzaki), Schallmoose, near Salzburg (Richter), Carinthia (Lemann)—Raiblerthal (Mann), Dalmatia—Spalato (Meyer-Dür), Carniola, everywhere (Mann), Styria—Hausdorf (Fritsch). BELGIUM: throughout, common—the whole of the right bank of the Meuse, particularly abundant in Luxembourg (Sibille), Dinant (Baudart), Tirlemont (Halflants), Louvain (Schammel), Marchovellete (Wautier), Beez, Namur (Lambillion), Fond d'Arquet (de Radiguès), Godine (Crombrugghe), Brussels (Haverkampf), St. Servais (Castin), Ortho (Slégers), Rhode-St.-Genèse (Hennin). BOSNIA AND HERCEGOVINA: widely distributed, and common up to 1600m.—Dervent (Hilf), Koinsko Polje (Sturany), Sarajevo (Rebel), Romanja Planina, Treskavica (Apfelbeck), Kalinovik (Schreitter), Prozor, Maklenpass, Vranica Planina, Radusa Planina, Jablanica (Hilf), Nevesinje

(Uhl), Lakat (Apfelbeck), Ubli (Hilf). Bulgaria and East Roumelia: distributed—near Sophia, common, near Slivno, the Rilska Valley, the Rilo district, to 1500m. (Nicholl), near Rustschuk, Varna (Lederer), Schipka (Rebel). Channel Islands: Jersey—once only in the Swiss Valley, St. Saviours (Piquet). Corsica: Ajaccio (Mann). Denmark: Skovlysninger, Torvemoser (Bang-Haas). Finland: south and southeast (Lampa). France: throughout—Calvados (Moutiers), Brittany (Griffith), Pont de l'Arche (Dupont), Forêt d'Arques, near Dieppe (Moore), Tancarville (Leech), Manche—Cherbourg (Nichollet), Ille-et-Vilaine—Rennes, Monterfil (Oberthür), Paris district (Bellier), Indre—Brenne (Martin), Aube (Jourdheuille), Seine-Inférieure—Duclair (Smallman), Seine-et-Loire (Constant), Doubs—Besançon (Bruand), Allier—bois de Chavagnac, Moulins (Peyerimhoff), Puy de Dome (*teste* Speyer), Auvergne—Nohant, St. Florent, Guérit (Sand), Isère—Uriage, Haute-Savoie—Chamonix, Savoie—Aix-les-Bains, Mont Revard (Oberthür), Monnetier (Blachier), French Pyrenees (Rondou), Basses-Alps—Digne (Tutt), Aude—La Malepyre (Mabille), Alpes-Maritimes—Vésubie (Oberthür), Draguignan, Languedoc — Nîmes (Tutt), Gironde (Brown), Pyrénées-Orientales — Vernet-les-Bains, (Oberthür), Hautes-Pyrénées — Cauterets, Basses-Pyrénées — Biarritz, Haute-Vienne—Limoges (Oberthür), Provence—Cannes, Pegomas, Auribeau, l'Esterel, Hyères, Carqueiranne (Tutt), Cevennes (Rowland-Brown). Germany: Prussia, very common—Rastenburg, Insterburg, Willenburg, Thorn (Schmidt), Memel, Tilsit, Cranz, Powayen, Capornsche Haide, Wargen, Drugehnen, Dammhof, Gross-Raum, Metgethen, Königsberg, Löwenhagen, Tapiau, Wehlau, Pillkallen, Friedland, Bartenstein, Petershagen, Ludwigsort, Mohrungen, Osterode, Allenstein, Sorquitten, Rominten, Goldap, Lyck, Johannisburg, Arys, Neidenburg, Graudenz, Elbing, Danzig, Zoppot, Karthaus, Alt-Kischau, Lonsk, Jastrow (Speiser), Pomerania, throughout — Julow, etc. (Hering), Endingen, Pennin, Grubenhagen (Paul and Plötz), Mecklenburg-Schwerin and Mecklenburg-Strelitz, everywhere common—Lübeck (Tessmann), Schwerin, Waren, Parchim (Gillmer), Friedland (Stange), Lauenburg, Hamburg, and Schleswig-Holstein—Eutin (Dahl), Hamburg, Altona (Tessien), Bremen and Hanover—Bremen (Rehberg), Lüneburg (Machleidt), Hanover, Osnabrück, Hameln, Göttingen, Osterode (Jordan), Brunswick —Brunswick, Wolfenbüttel (Heinemann), Helmstedt, Quedlinburg (Jordan), foothills of the Hartz (Gillmer), Oberharz (Speyer), Westphalia—Münster (Speyer), Höxter (Jordan), Rhine Provinces, rather common—Crefeld, Uerdingen (Stollwerck), Elberfeld, Aachen, Trier, Barmen (Weymer), Hesse-Nassau, Oberhessen and Waldeck, distributed—Wiesbaden (Rössler), Oberursel (Fuchs), Hanau (Limpert), Frankfurt-on-Main (Koch), Cassel (Borgmann), Waldeck (Speyer), Rotenburg-on-Fulda (Jordan), Thuringia—Gotha, Erfurt, Seeberg, Boxberg, Krahnberg (Knapp), Rudolstadt (Jordan), Province of Saxony—Zeitz-on-Elster—Knittelholz, Raabe, Ossig (Wilde), Halle, Dölauer and Dessauer Haide (Stange), Möst, Hirtenhau, Raumers Wiese, Triftlinie (Amelang), near Mühlhausen, Naumburg, Sondershausen, Nordhausen, Kyffhäuser (Jordan), Brandenburg—Berlin district (Bartel), Neiderneundorf (Dadd), Frankfort-on-Oder (Kretschmer), Posen, everywhere (Schultz), Silesia—Brieg (Döring), Seefelder near Reinerz (Standfuss), Trebnitzer-Gebirge (Nohr), Upper Lusatia (Möschler), Sprottau district, Mückendorf, Dittersdorf, Sprottischwaldau, Oberleschen, Meilerkänigt, Ebersdorf, Wichelsdorf, etc. (Pfitzner), Kingdom of Saxony—Dresden (Steinert), Saxon Upper Lusatia — Rachlau, Löbau, etc. (Schütze), Freiberg-i.-S. (Fritsche), Chemnitz (Pabst), Leipzig (Speyer), Bavaria—Regensburg (Hofmann and Herrich-Schäffer), Münich (Kranz), Augsburg (Freyer), Kempten (v. Kolb), Württemberg, common (Keller), Baden — Freiburg, Lahr, Durlach, Heidelberg (Reutti), Carlsruhe (Gauckler), Alsace—Forêt de Lutterbach (Gerber), Doller (Michel), Basle, banks of the Weise, etc. (Peyerimhoff), the Pfalz (Bertram). Greece: throughout—Islands, etc. (see p. 230) (Lederer). Italy: throughout Tuscany (Stefanelli). Apennines—near Boscolungo (Norris), Puzzuoli (Zeller), Roman Campagna (Calberla), Florence, banks of Arno (Smallman), Liguria (Speyer), Italian Riviera — Alassio, etc. (Tutt), Genoa (Walker), Piedmotese valleys—Susa (Brown), Certosa di Pesio (Norris), Cogne, Locarno (Tutt), Lugano, etc. (Chapman), Orta (Lowe), Lombardy—Monti di Vill'Albese, etc. (Turati), Sicily, up to 1400m. — Palermo (Mann), Madonie mountains—Monreale, M. Pellegrino, S. Martino (Mina-Palumbo), Osimo (Spada). Netherlands: Friesland, Gröningen, Overijssel, Limburg, Gelderland—Harderwijk, Brummen, Empen, Doesborgh, Doetinchem, Gendringen (Snellen). Roumania: Costischa, etc. (Fleck). Russia: Baltic Provinces, common (Nolcken), Caucasus district (Bramson), Ural district—Casan, Simbirsk, Orenburg, Saratov (Eversmann), Govt. Wolgoda—Eisenbahn station, Kotlas (Kroulikowsky), St. Petersburg district (Albrecht). Scandinavia: generally up to 62°N. lat. (Aurivillius), north

west Norway—Naes Vaerk, Christiania, Odalen, Drammen, Fagernaes-im-Amdal, Valders (Siebke), Disenaen (Standen), Fredrikstad, Hvalöerne, Sireosen, Siredal, Ose, Valle, Larkollen, Roikenoiken (Strand), Hunneberg (Lampa), Saeterstoen (Chapman), Sweden—Scania, Helsingland (Lampa), Lapland, Gottland, Ostrogothland (Zetterstedt). Spain: near Granada (Staudinger), Aragon—Mont Sény (Nicholl), Cantabrian mountains—Puerto de Pajares (Chapman), Castile—Alsasua (Oberthür), Albarracin district—Losillo, Valley de Masegar, Moscardon (Zapater), Catalonia—Montserrat (Standen). Switzerland: throughout the lowlands, and often common up to 6000 feet, going singly up to 7000 feet (Frey)—in the Riedt, near Wallisellen (Dietrich), Martigny, Branson, Sépey, Gryon, Saillon, Sion, Sierre, Grand Ferrex (Favre), Aigle (Sloper), Macolin (Lowe), Veytaux, Bérisal, etc. (Wheeler), Berne (Flemyng), Weissenburg (Huguenin), the Juras—St. Georges, etc. (Wheeler), the Gemmi, at 5300 feet (Speyer), Montreux to Aigle (Barraud), near Geneva (Muschamp), Saas-Fée, Simplon (Blachier), Lucerne (Lang), Andermatt (Jones). Turkey: Port Baklar (Walker), Crete (Mathew).

## Tribe: Nisoniadidi.

This tribe is closely allied to the Erynnid species of the last tribe, *viz.*, *Erynnis alceae*, *E. altheae* and *E. lavaterae*. Under the name *Thanaos*, Watson describes (*Proc. Zool. Soc. Lond.*, 1893, p. 69) the tribe as follows:

> Antennæ with club moderate, more or less bent into a curve, bluntly pointed. Palpi porrect; second joint laxly clothed; third joint almost concealed, bluntly conical. Forewing with inner margin longer than outer margin; male with a costal fold; cell of forewing less than two-thirds the length of costa; discocellulars slightly inwardly oblique, the lower the longer; nervure 3 shortly before the end of cell; nervure 2 slightly nearer to base of wing than to end of cell. Hindwing with outer margin evenly rounded; nervure 7 very close to end of cell; discocellulars and nervure 5 faint; nervure 3 immediately before end of cell; nervure 2 almost equidistant from end of cell and base of wing. Hind tibiæ fringed with two pairs of spines, the upper pair minute.

The two genera usually included in the tribe are—(1) *Nisoniades* (type *tages*), in which the ♂ has a costal fold, and (2) *Thanaos* (type *marloyi*), in which the ♂ is without the costal fold, but we have already noted (*anteà*, p. 85) that *Thanaos* is really a synonym of *Nisoniades*, both having *tages* for type. Under the title *Thanaos*, Bdv., Scudder gives a very complete diagnosis of the American forms in all their stages (*Butts. New England*, ii., pp. 1445-1449), much too extended to be repeated in detail here. Among his general remarks, however, are many worthy of attention. He observes that "the butterflies are of moderate size for Hesperiines, have ampler wings than any other genera, excepting those immediately contiguous, and the scales seem to be more feebly attached, since the wings are very easily abraded. The bunch of short conical filaments which nearly fills the opening of the prothoracic spiracles, can be protruded to a considerable distance, so as to form a prominent tubercle-like swelling, which has not been noted in other Hesperiine genera."

Rambur was the first to notice the asymmetrical development of the abdominal appendage of the ♂ of *Nisoniades tages*. Scudder says that the same asymmetry is found in some of the neighbouring genera—*Achlyodes*, etc., and doubtless in some other groups (as it has been detected in a Heliconian). In an inconspicuous degree it has been observed in some other Urbicolids. The asymmetry, Scudder notes, is not only found in the lateral valves, which are sometimes of widely disproportionate size, and serve well, also, to distinguish the different species, but often also above, in the central hook, the posterior view of which shows it to be sometimes remarkably lopsided. The asymmetrical parts are entirely concealed by scales. The upper organ is

protected by an extensive posterior expansion of the terminal segment of the abdomen, which forms a projecting hood, and which is also provided at the tip with a heavy fringe of excessively long scales; the clasps are themselves furnished externally with a heavy coating of pretty long scales, which effectually hides the sculpture of the parts, although the disparity in length of the two clasps is readily seen (*e.g.*, *Thanaos brizo*). Scudder further states that, when a ♂ of one of these species is taken between the fingers, the insect frequently endeavours to use this apparatus as an organ of defence, or, perhaps it might be said, of aggression, much after the manner of a *Panorpa* or a *Staphylinus*. Of the structure of the genital organs, Scudder writes:

"The 8th abdominal segment is broadly produced above in the ♂, in a convex, entire, rounded plate, the whole fully three times as long as the preceding segment, and furnished with very long scales; the side-pieces (clasps) of the ♂ are fringed with numerous, not very long, hairs, and covered profusely with short scales, and are long and slender, directed a little upward, and apically inward. The upper organ varies exceedingly in shape and proportionate size; the centrum gibbous, subovoid, contracted towards the tip, and bearing, at the extremity, a pair of hooks, occasionally consolidated, and from the inferior junction of which, a minute, appressed, central plate or tooth, dentiform on a side view, frequently depends; near the middle of the upper portion of the centrum, the surface is either simply a little elevated, or expanded, after elevation, into nearly horizontal alations, or it rises into a dorsal, usually horseshoe-shaped, crest, the sides of which sometimes form conspicuous lateral expansions, the whole crest being frequently asymmetrical in elevation and lateral extension, and bearing, on its upper edge, an armature of spines; from the middle of the upper surface, lateral arms extend downward, and then curve backward, meeting behind, and, at their united extremities, expand into a transverse, usually broad, field, the inferior armature well provided with spines or bristles. Besides the asymmetry of the dorsal crest referred to, the lateral arms, the terminal hooks, and the inferior armature, frequently partake of the same peculiarity; indeed, this element seems to pervade every part of the remarkable genital armature in this genus. With some minor exceptions, the left clasp is always more highly developed than the right, both in the configuration of the whole, and in the sculpture and armature of the details; each clasp may be divided for convenience of description, into two parts—an upper and a lower; the upper portion is ordinarily developed as a broad lobe, armed on its upper edge with a row of very long, stiff bristles, pointing backward; it has a tendency to expand in two directions, forming what are called the upper and hind processes, according to their position; the lobe is generally smaller in the left clasp than in the right; and the hind process either wanting, or minute, in the left. The lower part of the clasp is a very long, slender, usually compressed, often twisted, and invariably curving, blade, frequently spined or pointed at tip, its origin marked below by a denticle; it bears, at the base of the upper edge, a short, frequently bent or curving process, ordinarily somewhat triangular in shape, and very often armed with spinules; sometimes this process is wanting on the right clasp, and it is usually more slender, and frequently longer, on the left than on the opposite side; at their base, the clasps form a large, broad, compressed, somewhat gibbous plate, of variable form."

The movement of the clasps is, of course, lateral, and that of the upper organ, vertical; but some of the constituent parts of the latter have an independent motion, the whole central apparatus, including the hooks, having a common vertical movement upon the centrum, and the central tooth a forward and backward swing upon the apical portion.

Closely allied species vary in the amount of development of the costal fold and its enclosed androconia. These latter were described at length by Aurivillius (*Bid. Svens. Vet. Akad. Handlingar*, v., p. 32), and Scudder observes that an examination of the androconia has shown, so far as these scales are concerned, how colsely some of the species are related to each other,

and how very distinct others are that were supposed to be doubtfully separable. He notes of their structure that "the dermal appendages of the ♂, concealed in the costal fold of the forewing, consist of long, basally pediform, bristles, sometimes replaced by slender, sublanceolate, flagellate, androconia, or by slender twisted ribbons; sometimes accompanied also by rod-like bristles, occasionally two-pronged at tip, and by small, apple-seed-shaped, androconia."

The differences between the Nisoniadid and Hesperiid eggs are well shown in our pl. iii., fig. 1 (*Nisoniades tages*) and fig. 2 (*Hesperia malvae*), and these differences would appear to be constant between the groups, as the American Nisoniadid eggs are described as "very short, sugar-loaf-shaped, with a moderate number of straight, not very prominent, vertical ribs, extending from base to micropyle, the surface between them depressed in regular curves, traversed also by numerous, delicate, transverse, raised lines; the micropylar rosette a little depressed, consisting of a few rather large, roundish-oval or kite-shaped plates, surrounding a central minute circle, and bounded by a number of oval, angular cells, the outermost larger than the others."

We may here add a note of Doherty's (*Journ. As. Soc. Beng.*, lv., pt. 2, p. 113), who says that "a kind of hermaphroditism seems to occur sometimes in the *Hesperiadae*. From the body of apparent ♂s of *Suastus eltola* and of *Coladenia dan*, both having perfect prehensores of the form characteristic of their respective species, I obtained one or two well-developed eggs, exactly similar to those taken from the ♀s of the same species; also, from a ♂ of *Suastus toona* (the egg of that species being, except for this, unknown to me) I obtained a single, immature, blood-red egg." Doherty's knowledge of butterfly eggs was so extensive that we are astonished some remarks on this statement have not been made.

The larvæ are slow and sluggish in their habits, and their genera appearance and structure are well illustrated by our figure of *Nisoniades tages* (*posteà*); the large head, the constricted prothorax, the plump and arched body, and the prothoracic dorsal shield, are all characteristic. In the early stages, the setæ i, ii, iii, iv and v are expanded apically, those of the upper rows being much more so than the others; the subspiracular hairs of the prothorax, like those of the head, being but slightly expanded. These expanded bristles are to be found (at least up to the 4th instar), and are described and figured by Chapman (*Ent. Rec.*, xvii., pp. 281-2, pl. xi). He observes that the larva of *N. tages*, in its first instar, has a transparent hair with clubbed end, divided into several points, assuming more or less a fan-shape, whilst, in the 4th instar, the larva possesses hairs of a trumpet-shape, as well-developed as those of the pupa of *Chrysophanus phlaeas*, and very different from the more baton-like hairs of the earlier instars. The trumpet-hairs stand upright, are transparent, and very minute, only 0·03mm. to 0·04mm. high, but appear to be definitely of trumpet or calyx form, at their bases of origin about 0·005mm.-0·007mm. wide, and spreading out at the top to a fimbriated, or spiculated, circular margin, 0·02mm.-0·03mm. across, the central opening apparently reaching quite to the base. These bases are the ordinary raised rings, with circles of articulation in the centre, found at the base of all ordinary tubercular- or skin-hairs; they are, however, very small (0·02mm. across), not wider than three skin-points. Scudder observes that, after the 4th instar,

the apically-expanded bristles are lost and our plate of the hairs in the last skin shows the great change that has occurred (compare plates vi. and vii.). He further observes that the larvæ are provided with a laterodorsal series of chitinous annuli, placed in the middle of the anterior half of each segment of the body, a laterostigmatal series of similar annuli directly above stigmata, and a ventrostigmatal series, two to a segment, near together, in advance of, and behind, the middle. These are the lenticles, one of which is shown in our plate of "the skin of the larva of *N. tages* (pl. vi., fig. 1)," and which Chapman says is about 0·025mm. in diameter, a dark chitinous ring, filled with an apparently structureless membrane. This same plate gives also a fairly good idea of the formation of skin-points, as well as of the trumpet-hairs and lenticle. The spiracles are long, oval, delicate, and slightly elevated. The prolegs are short, rapidly tapering, apically broadly ovate, with a complete double row of outward-curving hooklets, which are very small, not very delicate, nor very sharply pointed, but tapering throughout. Our plates vi and vii give a good idea of the various changes that the larval hairs undergo in *Nisoniades tages*.

The Nisoniadid pupa (as represented by *Nisoniades tages*) is very similar to the Hesperiid (as represented by *Hesperia malvae*), but with more of the Sphingid curve (like that of *Sesia stellatarum*), the dorsum being hollow from the mesothorax to the 6th abdominal, the venter prominent at the ends of the appendages, but hollow opposite the metathorax. Describing the American forms, Scudder says that "the head is somewhat distinct from the thorax, the ocellar field being subglobose, prominent, and the anterior extremity between the eyes independently, and considerably, tumid, accentuating their prominence, the whole broad, scarcely depressed. Thorax tumid, and regular, above, basal wing-tubercles slight, but enough to make the thorax just wider than the eyes, faintly and obliquely carinate in nearly the direction of the antennæ. The upper surface of the head and thorax to the summit of either, forms a straight, unbroken line, when viewed laterally, with a considerable slope, at an angle of about 45° with that of the lower surface, as far as the swollen apical half of the wing-cases, where the body is largest. On the abdomen, on the contrary, the upper surface is straight, or scarcely concave from the height of the thorax to the last segment, while the under surface continues the posterior curve of the wing-covers, curving rather strongly upward apically, so that the whole lateral aspect of the chrysalis is that of a broad sigmoid curve. Viewed dorsally, the body is nearly equal from the basal wing-tubercles to the middle of the abdomen, with a scarcely perceptible constriction at the middle of the wings, and a distinct, though slight and broad, enlargement on their apical half; the apical half of the abdomen tapers rapidly. The thoracic spiracle-guards are moderately large, and semi-lenticular. There is no mandibular tubercle. The 2nd pair of legs extends a little beyond the base of the antennal club, the 3rd pair somewhat beyond the antennal tips, which are finely pointed, and the tongue a little beyond the wings, and almost to the tip of the 4th abdominal segment. Spiracles oval, nearly twice as broad as long, not prominent. Cremastral spine pyramidal, truncate, rudely quadrilateral, longitudinally and irregularly sulcated, the hooklets half as long, forming a flaring bunch.

The lifehistories of the species present the marked peculiarity that

the larvæ, being fullfed in autumn, do not pupate until the following spring, pupation taking place in a specially constructed hybernating chamber, which Scudder says may be the last larval nest, more perfectly closed. He says that the "larvæ of the Nearctic species live in little nests, made, upon the underside of leaves, either by cutting and folding over a fragment of the leaf, and fastening it securely to the other portion by strong distant bands of silk, or by uniting several leaves. Their nests are always scrupulously clean. The whole interior of the nest is lined with silk, and this is always sufficiently large to permit the inhabitant to turn about. The caterpillars of some species eat little irregular holes, or slits, upon either side of their nest, and this becomes a ready mode of discovering the insect." Our Palæarctic species prefer open ground—downs, sides of mountains, etc.—but Scudder says that the Nearctic species prefer overgrown recent clearings, or the thickets and woods, to which the ♀s confine themselves, while the ♂s are more fond of the neighbouring roads, playing about damp spots, and resting with spread wings, with a tameness apparently quite foreign to their nature in the thickets. In the woods, these insects roam about with a jerky flight, never far from the ground, but with so uncertain a movement, and such frequent change of course, that they are rather hard to capture, and the nature of their haunts among the thickets does not lessen the difficulty, etc. When resting at night, *Nisoniades tages*, as observed by Trimen, folds its wings roof-like over its back like a Noctuid moth, assimilating wonderfully to a grass-head, on which it usually elects to rest.

Scarcely represented in the Palæarctic area, the species are much more abundant in the Nearctic. Staudinger and Rebel (*Cat.*, 3rd ed., p. 98) only note *tages*, L. (Europe), *pelias*, Leech (China), *marloyi*, Bdv. (south-eastern Europe), and *montanus*, Brem. (eastern Asia), but Dyar (*Cat. Nth. Amer. Lep.*, pp. 59-61) gives 21 species as inhabiting North America. The group appears to be restricted to the north temperate zone, and Scudder suggests that its greater abundance in the Nearctic, than in the Palæarctic, area is to be expected from the occurrence of all the more closely allied genera in central America. In the Old World it extends from 35°N. to 60°N. lat., in the New World from 28°N. to 50°N. lat.; in both it extends from ocean to ocean, and from the plains to a considerable distance up the mountains; in the alps of central Europe to 5000 feet, in the White Mountains to 5000 feet, in the Rocky Mountains to some 9000 feet. No species seems to be common to the two regions.

## Genus: Nisoniades, Hübner.

Synonymy.—Genus: **Nisoniades,** Hb., "Verz.," p. 108 (1816); Stphs., "Illus.," iv., p. 404 (1834); Humph. and Westd., "Brit. Butts.," p. 123, pl. xxxviii., figs. 9-13 (1841); Stephs., "List," 1st ed., p. 21 (1850); 2nd ed., p. 20 (1856); Westd. and Hewits., "Gen. Diurn. Lep.," p. 519 (1852); Kirby, "Eur. Butts.," p. 121 (1862); Butl., "Cat. Diurn. Lep.," p. 286 (1869); Kirby, "Syn. Cat.," p. 628 (1871); Staud. "Cat.," 2nd ed., p. 34 (1871); Curò, "Bull. Soc. Ent. Ital.," vi., p. 216 (1874); Kirby, "Eur. Butts.," p. 64 (1882); Lang, "Butts. Eur.," p. 348 (1884); Kane, "Eur. Butts.," p. 145 (1885); Auriv., "Nord. Fjär.," p. 39 (1888); Dale, "Brit. Butts.," p. 226 (1890); Barr., "Lep. Brit. Isl.," i., p. 304, pl. xl., figs. 2-2*d* (1893); Rühl, "Pal. Gross.-Schmett.," p. 681 (1895); Tutt, "Brit. Butts.," p. 119 (1896). [**Papilio-Plebeius-**] **Urbicola,** Linn., "Syst. Nat.," xth ed., p. 485 (1758); xiith ed., p. 795 (1787); Fab., "Sys. Ent.," p. 535 (1775); Esp., "Schmett. Eur.," pl. xxiii., fig. 3 (1777); p. 306 (1779); Fab., "Spec. Ins.," pt. ii., p. 138 (1781); Berg., "Nomenklatur," p. 39,

pl. xci., figs. 3-4 (1780); Göze, "Ent. Beiträge," ii., pl. 3, p. 110 (1780); Fab., "Mant.," p. 92 (1787); Bork., "Sys. Besch.," i., pp. 188, 288 (1788); Brahm, "Ins. Kal.," ii., p. 363 (1791); Haw., "Lep. Brit.," p. 51 (1803). **Papilio,** Linn., "Faun. Suec.," p. 286 (1761); Scop., "Ent. Carn.," p. 181 (1763); Fuess., "Verz.," p. 32 (1775); Schiff., "Schmett. Wien.," 1st ed., p. 159 (1775); Rott., "Nat.," vi., p. 31 (1775); Harris, "Eng. Lep.," p. 6 (1775); Schneider, "Sys. Besch. Eur. Schmett.," p. 278 (1785); Geoff., "Fourc. Ent. Paris.," p. 247 (1785); Lewin, "Insects," etc., p. 94, pl. xlv., figs. 3-4 (1795); Hb., "Eur. Schmett.," pl. xci., figs. 4-7, p. 70 (1802); "Larvæ," etc., Lep. i., Pap. ii., Gens *Ea.*, figs. 2*a-b* (*circ.* 1802); Ill., "Schmett. Wien.," 2nd ed., p. 143 (1801); Ochs., "Die Schmett.," i., pt. 2, p. 214 (1808); Godt., "Hist. Nat.," i., p. 241, pl. xii *sec.*, fig. 4 (1821). **[Hesperia-] Urbicola,** Fab., "Ent. Sys.," iii., pt. 1, p. 354 (1783). **Erynnis,** Schrank, "Faun. Boica," ii., 1, p. 158 (1801); Ramb., "Faun. And.," p. 311 (1837); "Cat. Lep. And.," p. 83 (1858); Nolck., "Lep. Faun. Estl.," p. 82 (1868). **Hesperia,** Latr., "Hist. Nat.," xiv., p. 124 (1805); "Consid. Gen.," p. 208 (1810); Leach, "Edin. Ency.," ix., p. 130 (1815); Ochs., "Die Schmett.," iv., p. 34 (1816); Dalm., "Vet. Ak. Hand.," xxxvii., p. 204 (1816); Latr., "Enc. Méth.," ix., p. 780 (1819); Bdv., "Eur. Lep. Ind. Meth.," p. 26 (1829); Meig., "Eur. Schmett.," p. 63, pl. lv., fig. 4*a* (1830); Treits., "Die Schmett.," x., p. 248 (1834); Evers., "Faun. Volg.-Ural.," p. 85 (1844); H.-Sch., "Sys. Bearb.," p. 158 (1846); Dup., "Icon. Chen.," p. 219, pl. xxxii., fig. 93 (1849); Speyer, "Geog. Verb. Schmett.," p. 297 (1858); Newm., "Brit. Butts.," p. 170 (1869); Meyr., "Handbook, p. 357 (1895). **Thymele,** Fab., "Ill. Mag.," p. 287 (1807); Stphs., "Illus. Brit. Ent.," p. 98 (1828); Stphs., "Ins. Cat.," p. 26 (1829); Wood, "Ind. Ent.," p. 7, fig. 76 (1839); Westd., "Gen. Syn.," p. 88 (1840). **Thymale,** Oken, "Lehrb. Zool.," p. 758 (1815). **Thanaos,** Bdv., "Gen. et Ind. Meth.," p. 37 (1840); Dup., "Cat. Meth.," p. 38 (1845); Dbldy., "Syn. List," p. 2 (1850); Led., "Verh. zool.-bot. Gesell.," p. 26 (1852); Sta., "Man.," i., p. 66 (1857); Wallgrn., "Skand. Dagf.," p. 279 (1853); Auriv., "Bidrag Svensk. Akad. Handling.," v., p. 32 (1880); Frey, "Lep. Schweiz," p. 54 (1880); Buck., "Larvæ Brit. Butts.," i., p. 126, pl. xvi., fig. 3 (1886); Watson, "Proc. Zool. Soc. Lond.," p. 69 (1893); Grote, "Proc. Sth. Lond. Ent. Soc.," p. 59 (1897); Staud., "Cat.," 3rd ed., p. 98 (1901); Lambln., "Pap. Belg.," p. 295 (1902). **Syrichtus,** Hein., "Schmett. Deutsch.," p. 114 (1859). **Syrichthus,** Snell., "De Vlinders," etc., p. 82 (1867). **Thanaus,** Kirby, "Handbook," etc., iii., p. 13 (1897).

This genus contains a number of closely-allied species, chiefly North American. The original description of the genus reads (*Verzeichniss*, p. 108) as follows:—

The wings above dusted with grey, marked with white spots—*Nisoniades bromius*, Stoll.; *N. mimas*, Cram.; *N. zephodes*, Hb.; *N. juvenis*, Hb. (*juvenalis*, Abb.); *N. tages*, Linn., *Syst. Pap.*, 268; Hb., *Pap.*, 456, 457; *N. aurispex*, Hb.; *N. ophion*, Stoll.

Of these species, Hübner had already figured and described *tages*, an insect well-known to him, and it is, without doubt, the type of the genus. For the rest, the species are hopelessly heterogeneric. The type was actually fixed as *tages* in 1834, and confirmed, in 1850, by Stephens. *Thanaos*, Bdv., often used as a separate genus for *marloyi*, had its type specified as *tages* by Blanchard, in 1836, Boisduval having already, in 1836, figured this species under this name. *Thanaos*, therefore, falls as a synonym of *Nisoniades*. Staudinger and most other authors place in the same genus the divergent forms, *tages* (♂ with costal fold) and *marloyi* (♂ without costal fold). Speyer, however (*Can. Ent.*, x., pp. 148, 169-170), separates them, with some doubt, a doubt we do not share. His diagnoses of the two groups reads as follows:—

Antennæ half as long as the forewings, their club somewhat compressed, slender, gradually dilated, and then narrowed, and more or less acutely produced, regularly curved, lunate-falcate. Locklet long. Palpi projecting upon the front and nearly twice the length of the eyes, with long and thick hairs, but less coarse than

in *Pyrgus* and *Scelothrix*; the apical joint thick, bluntly conical, somewhat bent. Tibiæ unarmed, with long hairs. Forewings triangular, outer margin not toothed; fringe unicolored. ♂ with longer costal fold.—NISONIADES—*montanus*, Brem.; *tages*, Linn.

Club of antennæ elongated, curved, shorter than in *Nisoniades*, suddenly swollen, and scarcely contracted at the well-rounded tip. Forewings more elongated than triangular, the front margin more steeply arched above the base, the hind margin shorter. ♂ destitute of the costal fold. All the other characters, as in *Nisoniades*.—HALLIA [THANAOS]—*marloyi*, Bdv.

*Thanaos*, as has been already shown, is a synonym of *Nisoniades*, having the same type, *tages*. We have, therefore, suggested HALLIA to take its place, and would name *marloyi*, Bdv., the type.

Speyer (*op. cit.*, p. 169), writing of *Nisoniades*, notes that "the peculiarly native country of this genus, scarcely represented in Europe, is North America. The characteristic feature is the form of the club of the antennæ, which is fusiform when stretched out, but which takes the form of a narrow crescent when in its regularly curved condition. This fundamental form is constant; the stoutness of the club and its degree of acuteness differ according to the species. In some American species it is very slender and finely pointed; in others, as in *N. tages*, it is thicker and more blunt, but never so suddenly rounded as in *Scelothrix* or *Thanaos* (*Hallia*, *suprà*). The species *montanus*, Brem., is distinguished by the particularly large hindwings, with expanded margin, also by the difference of colour and marking; the antennal club is somewhat thicker than in *N. tages*, but is otherwise of the same shape."

With regard to the costal fold, by means of which *Nisoniades* (as here restricted) is to be specially distinguished from *Hallia*, Aurivillius gives (*Bid. Sv. Vet. Akad. Handl.*, v., p. 33) the following detailed account (with figures) thereof. He writes: "As in the preceding genus (*Hesperia*), the male here is also furnished with a so-called costal fold. This costal fold of the Hesperiids has long been known, and also been made use of as a sexual character by many authors. The structure, as far as I know, has never been exactly described. With the aid of the figures 24 and 25, the first of which depicts the fold in section, and the latter the same unfolded and viewed from the upperside, I will endeavour to give a more exact description of the structure. When it is quite closely folded over, it appears merely as a thickening of the costa, and the scales are set into each other so closely that it is difficult to discover the opening. If one makes a section of it in this condition, one finds the roof of the tube thus formed consists mostly of large and long scales (*a*) attached to the edge of the costa; these meet other similar scales (*f*), which stand almost upright from the wing membrane, along the lower margin of the tube. The costal margin (*b*) is very narrow and insignificant; then a tube (*g*), immediately following this, runs along the wing, which tube does not, like the usual wing-nervures, form a swelling or elevation on the underside, but on the upperside, of the wing. This tube occurs in both sexes, and also in those species in which the costal fold is absent, though, in these latter it is less developed. It appears to me as though one could look on it as a true costal nervure, which one so far has denied to the butterflies, which may easily be explained, for this rib, looked at from that point of view, appears only as a dark band running along the costal margin. That it is really a tube may be also perceived from the fact that it

contains a trachea with air. A section through the wing at once also clears up all doubt. It certainly would be impossible for the ♂ to open and close the costal fold, if just this very rib were wanting. In the ♂, this rib is covered on the upperside with scales (*c*), all of which have their apices directed backwards from the costal margin. The anterior, which are, therefore, also the upper ones, are the longest, and cover all the rest, which gradually become shorter. As the large scales, situated on the edge of the costa, lie in quite an opposite direction, there is a sharp boundary between these two parts, like a hair-parting, where one sees (fig. 24*b*, 25*b*) a narrow margin of the outermost, quite naked, portion of the wing-membrane. Along the dorsal side of the costal nervure, the wing-membrane is, for a width which is almost equal to that of the costal nervure, almost wholly naked, being covered only with very small and short scale rudiments (*d*), the reason of this is easy to understand when one observes the fold in its closed (folded) condition. Here the costal nervure finds good space when bent inwards, and here the hinge of the fold is found, namely, just behind the swelling of the costal vein. Behind the naked space lies a fourth area (*e*), which is also just as wide as the last two. This space is almost entirely covered by the large covering-scales which stand up behind it. It is the spot where the androconial scales are fastened. These (fig. 23) are here quite fine, like hairs. . . . This genus, therefore, differs very much from the preceding (*Hesperia*) in the shape of the male scales, while the costal fold otherwise is formed in the same manner in both genera."

## NISONIADES TAGES, Linné.

SYNONYMY.—Species: **Tages,** Linn., "Syst. Nat.," 10th ed., p. 485 (1758): 12th ed., p. 795 (1767); "Faun. Suec.," p. 286 (1761); Fab., "Sys. Ent.," p. 535 (1775); Fuess., "Verz.," p. 32 (1775); Schiff., "Schmett. Wien.," 1st ed., p. 159 (1775), etc. **Morio,** [var.] Scop., "Ent. Carn.," p. 181 (*excl. cit.* Roesel) (1763). **Geryon,** Rott., "Naturf.," vi., p. 31, no. 19 (1775). **Tajes,** Bork., "Sys. Besch.," i., p. 288 (1788). **Cervantes,** [var.] Grasl., "Ann. Soc. Ent. Fr.," p. 558, pl. 17, B., 1, 2 (1836); Ramb., "Faun. And.," p. 311 (1839); "Cat. Lep. And.," p. 83 (1858); Frr., "Neu. Beit.," p. 417, fig. 3 (1845). **Unicolor,** [var.] Freyer, "Neu. Beit.," vi., p. 37, pl. 505, fig. 1 (1852); Staud., "Hor. Soc. Ent. Ross.," vii., p. 86 (1870). [N.B.—All other references mentioned under the generic synonymy (*anteà*, pp. 259-260) are referable to *tages*.]

ORIGINAL DESCRIPTION.—*Papilio Plebeius tages.* Alis denticulatis divaricatis fuscis obsolete albo-punctatis. "Fn. Suec.," 1082; Geoff., "Paris.," 2, p. 68, no. 39. Habitat in Europa. Similis *P. malvae*, sed magis fuscus (Linné, *Sys. Nat.*, 10th ed., p. 485). [*Papilio tages* alis subdenticulatis divaricatis fuscis obsolete albo-punctatis. Habitat in pratis rarius. *Descr.* Parvus præcedentis (*malvae*) magnitudine. Caput pilosum. Alæ fuscæ, utrinque adspersæ punctis albidis obsoletis (*Fauna Suecicae*, 2nd ed., p. 286).

IMAGO.—26mm.-32mm. Anterior wings dull brown in colour; the outer margin narrowly darker; a more or less broken transverse band of darker brown longitudinal spots before, and another similar one beyond, the middle; the space between, and narrowly on either side of, these bands, pale grey; a row of tiny white spots on the extreme outer margin; two or three other small white costal dots quite close together on the inner edge of the outer (elbowed) transverse band; the fringes of the same tint as the ground colour shaded with white basally. Posterior wings of the same tint as the darker bands of the forewings;

a row of small white dots on outer margin; a wavy transverse row of pale spots parallel with the outer margin, sometimes well-developed, at other times nearly obsolete; fringes of the same tint as the hindwings, tipped externally with grey.

Sexual dimorphism.—The sexual dimorphism of this species is most marked. Not only has the ♂ a strongly-developed costal fold, filled with very specialised androconia, the ♀ being without this structural peculiarity, but the colour and markings usually show distinct sexual characteristics. The ♂ costal fold of this species has already been described (*anteà*, p. 261). The special androconial scales of this species are quite fine, like hairs, 0·45mm.-0·5mm. in length, 0·0045mm. wide, blunt, with a golden gloss; they have rough uneven edges, and are distinctly hollow inside (Aurivillius).

Variation.—This species exhibits a considerable amount of minor variation, nor is this in any wise confined to a difference between the specimens of the first and second broods, although the second brood examples from southern Europe appear to be of a much deeper brown hue than any others examined. The spring specimens appear to be, on the whole, somewhat larger than the summer ones, although many exceptions occur. The spring examples vary, however, considerably in the ground colour, some being rather pale drab-brown, others deep fuscous-blackish, whilst the transverse bands show every intermediate stage between solidly united longitudinal lineolæ, stretching for some distance across the wing, to almost absolute obsolescence. The most striking variation, however, is to be seen in the median area, the space between the two dark transverse bands being sometimes wholly filled up with grey (white) scales, frequently extending into the outer and basal areas, giving the appearance of alternate dark and pale transverse bands. The marginal row of dots, too, varies greatly in intensity, being sometimes very clearly marked, at other times more or less obsolescent, whilst the three little characteristic costal dots may be reduced to one or even none, or continued faintly through the outer transverse band. The hindwings have a similarly variable outer marginal row of white dots, and a faint indication of a central band of pale spots, which suggests, in the best marked examples, an analogy with the transverse band of *Hesperia malvae*. The undersides of British (and European) examples vary scarcely at all; they are of an almost unicolorous brown colour (sometimes somewhat brighter, at others duller), and, as the insect sits with its wings deflexed, and not with its undersides exhibited, it will be seen that there is no need for pattern (or variation) on the undersurface. An exception, however, occurs in the eastern race, var. *sinina*, in which a row of pale (whitish) spots traverses the underside, and forms a conspicuous character. Of the more or less casual references to the variation of this species, we note that Kane says that, in Galway and Fermanagh, the specimens have very distinct grey markings on the forewings. Raynor observes that, in the Hazeleigh district, where the species is abundant, it varies a good deal in the coloration of the forewings, one example having the forewings of a deep brown-black, with all the pale markings suppressed, except the series of white spots along the outer margin. Miss Fountaine says that the eastern Europe and Asia Minor examples seem somewhat darker, and less varied in pattern. Haberhauer notes that, in the

Rilo mountains, the specimens are unicolorous, without definite markings; whilst Penther records that, on the Grand Prenj mountain, at from 300m. to 1900m., very dark examples are found from the middle to the end of July. Mrs. Nicholl considers that the form at Granada is something very near *unicolor*, although she also records *cervantes* as occurring in the same neighbourhood. Lowe notes ab. *unicolor*, or an approximate form, at Susa, described by Wheeler (*Butts. of Switz.*, p. 8) as "ab. *approximata*, so-called because approaching the var. *unicolor*"; whilst Lambillion (*Cat. des Pap. de la Belgique,* app. p. iv) describes an ab. *minima* as being about "half as small again as the type, the wings darker, with the markings ill-defined. Captured at Jambes (August, 1904), Denée (May 25th, 1904)." Zeller observes that the Carinthian specimens, taken on the Prediel in May and the first half of June, were decidedly larger than the German (Posen) ones, but, as those collected at Bruck-on-the-Mur, in the beginning of August, do not differ much from the latter in size, he queries whether the second brood in the Carinthian Alps does not consist of equally small specimens. On examining the long series in our cabinet from various localities, we have made the following notes: Spring examples—(1) Digne, April, 1897: ♂ s and ♀ s with forewings very uniform drab-brown; the ♀ s hardly greyer than the ♂ s; the forewings fairly well-marked; two transverse rows of elongated dark spots, one before and one beyond the middle; some medially marked with grey; white marginal dots well-marked; costal dots 1 to 3; hindwings from unicolorous to others with fair transverse pale band; marginal dots distinct. (2) Cannes, March and April, 1898, 1899, 1903: More uniform in drab-brown tint, less mottled than those from Digne; the ♂ s particularly unicolorous, with the transverse, brown, lineated bands ill-marked; the ♀ s more distinctly banded, greyish medially, and larger in size; the hindwings particularly uniform, except in one or two well-marked ♀ s; the white marginal dots very indistinct in some examples, particularly on hindwings; the broken-banded ♂ s have a particular *alceae*-like appearance; one ♀ almost absolutely unicolorous, except for a single white costal dot (bands, marginal dots, etc., obsolete), colour quite sooty-fuscous. (3) Draguignan, May 2nd-6th, 1905: The largest in the collection, drab-brown in tint, variable in the amount of transverse markings; the grey exceedingly well-marked in some ♀ s; traces of double pale band crossing the hindwings. (4) Carqueiranne, 1 ♂, April 26th, 1905: Like those from Cannes. (5) Brünnen, May, 1902, 2 ♂ s: 1 ♂ rather small, fuscous-black, with grey shading medially, unicolorous hindwings; the other larger, almost unicolorous fuscous-black, with white marginal dots on fore- and hindwings, nearest to the Pontresina form. (6) Pontresina, 2 ♂ s, 1 ♀, July 1st-12th, 1900: Very dark blackish-brown, the outer marginal area, the two transverse bands, and basal blotch, very deep in tint; the spaces between the darker bands grey, the median area particularly strongly banded; the row of white marginal dots conspicuous; fringes of forewings with basal half tinged with grey; hindwings very deep blackish-brown, with conspicuous row of tiny white marginal dots; outer edge of fringes pale. (7) 1 ♂, Saeterstoen, June 25th, 1898: ♂ small, drab-brown, almost unicolorous. Summer brood—(1) Susa, 4 ♂ s, August, 1897: Rather bright brown tending to unicolorous, with only slightly darker brown bands, and paler (almost ochreous) speckling. (2) Grésy-sur-Aix, July, 1898, August, 1897: 9 ♂ s, very like the Susa

examples; 3 ♂s deeper tinted, darker brown markings; nearer the Torre Pellice specimens. (3) Torre Pellice, July 25th-31st, 1901: Deep rich sooty-brown in both sexes; 8 ♂s and 2 ♀s, inclined to unicolorous, with 2 ill-developed darker transverse bands almost lost in ground colour, no grey shading; 2 ♂s and 1 ♀, of the same deep fuliginous tint, but with a slight tinge of grey in the discal area; in all, the marginal row of white spots small and conspicuous, hindwings unicolorous fuliginous-brown; 2 ♂s paler brown, like the examples from Susa. (4) Fusio, 1 ♂, almost exactly of the dark brown Torre Pellice form. Wheeler notes (*Butts. of Switz.*, p. 8) that there are 3 directions in which individuals of this species vary, *viz.* (1) Distinctness of markings, sometimes almost obsolete. (2) Colour of lighter central band of upperside of forewings—brown, grey, or slightly reddish. (3) Extent of inner line of white dots on upperside of wing, varying from a single spot on the costa to a complete series. The specially described forms are as follows:—

1. Ground colour dark brownish-black tinged with violet, and wide, greyish, median band = ab. *isabellae*, Lamb.
2. Dark black-brown, with two wide black transverse bands; the outer edged with grey; the median space reddish = var. (*et* ab.) *cervantes*, Grasl.
3. Uniform blackish-brown = var. (*et* ab.) *unicolor*, Frr.
4. Very light grey in colour = ab. *clarus*, Caradja.
5. Grey-green ground colour, with distinct black and white markings = var. *popoviana*, Nordn.
6. Pale grey in colour, strongly marked, central fimbria pale; underside with pale spots = var. *sinina*, Grum-Grsh.

This tabulation, however, is not at all characteristic of the forms of western and southwestern Europe, and the following tabulation perhaps better comprises those that have come under our notice—

| | |
|---|---|
| 1. Drab-brown .. .. | With transverse markings obsolete = *tages*, Linn.<br>With ill-developed transverse markings = ab. *alcoides*, n. ab.<br>With well-developed transverse markings = ab. *transversa*, n. ab.<br>With strongly grey median area = ab. *variegata*, n. ab. |
| 2. Warm fuliginous-brown | With transverse markings obsolete = ab. *brunnea-unicolor*, n. ab.<br>With ill-developed transverse markings = ab. *brunnea-alcoides*, n. ab.<br>With well-developed transverse markings = ab. *brunnea-transversa*, n. ab.<br>With strongly grey median area = ab. *brunnea-variegata*, n. ab. |
| 3. Blackish-fuscous .. | With transverse markings obsolete = ab. *unicolor*, Frr.<br>With ill-developed transverse markings = ab. *suffusa-alcoides*, n. ab.<br>With well-developed transverse markings = ab. *suffusa-transversa*, n. ab.<br>With strongly grey median area = ab. *suffusa-variegata*, n. ab. |

Of the forms noted in this tabulation, one often finds traces of the grey scaling medially, in both the *alcoides* and *transversa* forms, without their developing into a marked grey band, and without an inclination for the grey to extend beyond the dark transverse bands, as is the case in *variegata*. Such a tabulation as this is, of course, at best, only an approximation to the actual variation, and leaves much undealt with and unnoticed.

Of the hitherto-described forms, we suspect *isabellae*, Lamb., to be a modification of ab. *suffusa-variegata*: *cervantes*, Grasl., a special development of ab. *suffusa-transversa*, into a local southern race, whilst *clarus*, Carad., *poporiana*, Nordn., and *sinina*, Grum-Grsh., appear to belong to a paler race with grey ground colour that should precede our no. 1, "drab-brown," in the tabulation above, and not represented in our western examples. Bankes writes: "In the palest British specimen that I have seen, taken by myself in the Isle of Purbeck, on May 31st, 1893, all the wings have the ground colour of a pale raw umber-brown, with well-pronounced series of white spots; the forewings have a whitish median area, and well-developed, dark raw umber-brown, broken fasciæ = *fulva*, n. ab. My two darkest specimens are, one taken in the Isle of Purbeck in 1904, and one taken at Merthyr Tydfil, south Wales, by Mr. G. Fleming, in 1903; these have a blackish-fuscous ground colour, with well-developed transverse markings on the forewings, which also show the median area lightly, though somewhat partially, suffused with pale grey. One dark individual from Merthyr Tydfil has the central area of the forewings no paler than the rest of the wing, but in Dorset specimens this area is, in my experience, invariably paler, to a greater or less extent."

The specially described forms, already referred to, work out as follows:—

α. ab. *isabellae*, Lamb., "Rev. Soc. Ent. Namur," p. 15 (1902); "Pap. de Belg.," p. 296 (1902).—Of the shape of *tages*, but with the forewings a little less angulated, of a very dark velvety brownish-black, with the greyish band of the upper wings very wide, paler, and better marked than in the type. Hindwings blacker than in *tages*, with the white marginal points more conspicuous and better marked; but its best distinguishing characteristic is the violet reflection on all the wings, which is truly remarkable; in *tages*, the tint is greenish. Fond d'Arquet—every year occurs more or less common; examples, with the characters strongly marked, are, however, very rare (Lambillion).

Lambillion adds that *N. tages* is one of the most widely distributed species in Belgium, and one of the least variable; in some years, however, near Namur, this new aberration, in which the tint of the wings is different from that of the type, is not infrequent.

β. var. *cervantes*, Grasl., "Ann. Soc. Ent. Fr.," 1836, p. 558, pl. xvii., B. 1, 2 (1836); Rbr., "Faun. And.," p. 311 (1837); "Cat. Lep. And.," p. 83 (1858); Bdv., "Ind. Meth.," no. 310 (1840); Frr., "Neu. Beit.," v., p. 56, pl. 417, fig. 3 (1845); Staud., "Cat.," 2nd ed., p. 34 (1871); 3rd ed., p. 98 (1901); Rühl, "Pal. Gross-Schmett.," i. p. 682 (1895); Tutt, "Brit. Butts.," p. 121 (1896).—Alis fusco-subnigris; anticis, in extremo, atomis albis aspersis, duabusque fasciis nigris, transversis, sinuatis, denticulatis; fasciis externis, sexto dente majore; hac fascia nonnullis maculis cinereis in medio notata; posticis serie marginali maculis, maculaque subcentrali rufulis, paulum distinctis. Very similar to *tages*, but, independently of the fact that, in the smallest individuals, this species has the two transverse bands wider than in the largest *tages*, it also differs in the form of its wings, which are more elongated proportionally, and of which the anal angle is less prolonged, in its colour, which is much darker, and by other characters, which will be noticed in the following description: "Les quatre ailes sont d'un brun-noir, les supérieures qui sont un peu plus obscures, principalement en approchant du corselet, sont saupoudrées, surtout sur leur moitié extérieure, de petits atomes blancs très déliés, elles sont traversées, vers leur tiers externe par une bande noire un peu sinueuse, fortement dentelée sur les bords; mais plus du côté exterieur, où la sixième dentelure, à partir de la côte, se trouve être la plus grande. Le milieu de la bande noire vis-à-vis cette dentelure, offre une petite tache orbiculaire formée par les atomes dent j'ai parlé plus haut. On retrouve souvent de semblables taches, en face des autres dentelures, en descendant, mais moins distinctes à mesure qu'elles approchent du bas de l'aile; de manière que la bande semble formée par une suite de chaînons noirs, réunis, et

dont l'intérieur est gris. Cette même bande offre souvent auprès de la côte, surtout chez les femelles, deux petits traits blancs, longitudinaux, contigus, situés l'un au-dessus de l'autre. Ses dentelures, en outre, sont liserées extérieurement par des atomes d'un blanc plus ou moins grisâtre. On voit, sur le tiers interne de l'aile, une autre bande moins distincte et qui n'atteint point la côte; cette seconde bande se rapproche, sur le milieu de l'aile, de la première, à laquelle elle s'unit quelquefois. Entre les deux bandes et à leur bases, on aperçoit un espace presque orbiculaire, d'un brun roussâtre, plus clair que le fond. La frange, séparée par une ligne noire, de l'aile, est de la couleur de cette dernière, et parsemée de quelques poils blanchâtres. Une série de huit points blanchâtres, réunis à un égal nombre de points noirâtres, placés à leur côté interne, longe intérieurement la ligne noire qui sépare la frange de l'aile. Les ailes inférieures ont une teinte un peu plus roussâtre que les supérieures; leur surface offre une tache discoidale, quelquefois un peu lunulée, d'un gris roussâtre, et à peine distincte de la couleur du fond. On aperçoit une série marginale de sept autres taches de la même teinte, dont la troisième, à partir du haut de l'aile, est plus élevée que les autres. Immédiatement au-dessus de chacune de ces diverses taches, l'aile en présente une autre, cunéiforme, plus obscure que le fond. La ligne noire qui sépare la frange du fond des ailes inférieures, est longée intérieurement par une suite de points d'un gris roussâtre, peu apparents, dont souvent on ne distingue bien que les trois plus extérieurs. Le dessous est entièrement d'un gris roussâtre. La bande externe des premières ailes est remplacée par une serie très récourbée intérieurement auprès de la côte, de traits longitudinaux, larges, brunâtres, dont le septième et le huitième reproduisent, parfois, la tache blanchâtre de la bande de la surface opposée. Les secondes ailes, à la teinte près, offrent le même dessin qu'en dessus. Le corselet et l'abdomen, d'un brun-noir en dessus, avec un reflet roussâtre, sont d'un gris roussâtre en-dessous. Les palpes ont la forme de ceux de *tages*, mais leur dessus est brun, et leur dessous d'un gris cendré, ainsi que les poils du thorax. Les sourcils sont noirs; les antennes, de cette dernière couleur, sont finement annelées de blanc. La massue est un plus allongée et recourbée que dans *tages*. Les pattes ont le tibia couvert de poils d'un gris cendré. Les tarses sont d'un brun roussâtre. J'ai donné à cette *Thanaos* le nom de l'homme de génie qui fera toujours l'une des gloires de l'Espagne. C'est un faible tribut de ma reconnaissance pour les moments agréables que me procure chaque année son œuvre immortelle, que j'ai le bonheur de pouvoir lire dans sa propre langue. J'ai trouvé d'abord une femelle de cette espèce, le 26 de mai; elle volait sur les collines qui forment la base de la Sierra-Nevada. Dans la dernière quinzaine du mois de juin, nous en avons pris plusieurs autres individus, M le docteur Rambur et moi, sur les montagnes d'Alfakar; elle n'est pas commune, et il est rare de la rencontrer fraîche, car elle vole avec une grande rapidité, et presque toujours ses ailes sont déchirées. Elle aime beaucoup à se poser dans les chemins battus ou sur les clairières pierreuses des montagnes. Sa larve ne m'est pas connue. NOTA.—La femelle diffère peu du mâle; son abdomen est plus gros, et elle est un peu plus obscure; les deux petits traits blancs du sommet de la bande externe sont plus apparents, et les taches grises qui sont placées sur cette même bande sont quelquefois mieux écrites (Graslin).

Staudinger diagnoses (*Cat.*, 3rd ed., p. 98) this aberration as "paullo obscurior, alis anterioribus nonnunquam griseo-inspersis." Rambur notes (*Cat. Lep. And.*, p. 83) that "this insect is very near *N. tages*, ordinarily a little larger, of a browner tint, particularly at the bases of the wings; on the forewings the little white points on the costal edge, when they exist, appear to be placed less obliquely, whilst the whitish spots which border the fringe tend to unite and form a line, which is wider posteriorly, so that the brown band, of which the edge is more wavy, is a little farther from the margin in this part of the wing than in *tages;* the interior band is not so wide, is less regular, and appears almost broken on its anterior third; it is formed of black streaks, often more pointed on the outer side, and of which some beyond the middle are marked with small wider grey spots; the band nearer the base appears less sinuated on its internal, and a little more on its external, edge, so that it leaves posteriorly, between it and the preceding, a wider

space, which is filled up in this area by a reddish-brown patch, hardly visible in *tages*, where it does not alter the whitish-grey tint of this space. This inconspicuous spot is, however, characteristic, and is found in other exotic species. Sometimes the dark tint of the wings hides or obscures the markings. The underside is darker, and the small marginal dots have a linear form, and are larger on the forewings than in *tages*. Graslin discovered this form in the low parts of the Sierra Nevada," and Rambur says that he found it in the neighbourhood of Granada. Freyer notes (*Neu. Beit.*, v., p. 56) that "this insect, considered by Boisduval (*Ind. Meth.*, p. 319) as a variety of *tages*, shows remarkable difference, both in size and marking, being considerably larger, and of a browner colour (*tages* having ash-grey bands and spots); the most important character, however, is the absence of the white dots before the fringes, which, in *tages*, are most striking. The underside, too, is different, for, not only is it browner in *cervantes*, but the six small white spots on the forewings are shown sharply and distinctly; *tages* also does not possess the large pure white spot which *cervantes* shows so plainly between the 5th and 6th nervures, almost in the centre of the wing. *Cervantes* is altogether a much larger and heavier insect than *tages*."

γ. ab. (an *var.*) *unicolor*, Freyer, "Neu. Beitr.," vi., p. 37, pl. 505, fig. 1 (1852); Staud., "Hor. Soc. Ent. Ross.," vii., p. 86 (1870); "Cat.," 2nd ed., p. 34 (1871); 3rd ed., p. 98 (1901); Rühl, "Pal. Gross-Schmett.," i., p. 682 (1895); Tutt, "Brit. Butts.," p. 121 (1896); Lamb., "Pap. de Belg.," p. 297 (1902).—Under the above name Weissenborn has sent me a Hesperiid, with the remark that he received this single specimen from Frivaldszky, who had obtained it from the Greek Islands. I consider this specimen to be simply an uniformly brown-coloured aberration of *tages*, with which it agrees entirely in form and size. All the wings, as well as the thorax and abdomen, are uniform blackish-brown. The underside has quite the colour of *tages*, and behind the apex of the wing one discerns only two light dots; the colour is paler than on the upper surface. The antennæ are just as in *tages*. From *sericea* (=*marloyi*), to which it might also be referred as an aberration, it differs in form and size, and it lacks the white dots on the upper surface. It should, therefore, remain in collections under the first of these two names (Freyer).

Staudinger simply diagnoses this form (*Cat.*, 3rd ed., p. 98) as "Supra fere unicolor," but, in 1870, he had noted (*Hor. Soc. Ent. Ross.*, vii., p. 86) that, at the end of April and in the beginning of May, on the Parnassus, as well as on the Veluchi, and probably also on the Taygetos, as well as near Smyrna, *N. tages* had been taken, whilst Aber had found it in Corfu and Tinos. All the Greek specimens of *tages*, he says, are less marked than the German ones, the whitish scales on the upperside of the forewings being almost always absent, and the white marginal dots less distinct, and sometimes altogether absent. Staudinger further notes that he has a very good ♂ of this form from Weissenborn's collection (whence came Freyer's type), possibly taken in Crete. This form is rightly or wrongly recorded from:—Bulgaria: Rilo district (Haberhauer). France: Nice (Bromilow). Germany: Baden, Carlsruhe, Wernheim (Reutti). Italy: Certosa di Pesio (Norris). Roumania (Fleck). Spain: Granada (Nicholl).

δ. ab. (*an* var.) *clarus*, Carad., "Iris," viii., p. 61 (1895); Lamb., "Pap. Belg.," p. 297 (1902).—Typical *tages* and ab. *unicolor*, Fer., are abundant everywhere in Roumania from May to September; two specimens from Grumazesti are unusually large, dark, and distinctly marked, coming very close to var. *cervantes*, from Andalusia, East Sajan, and Hadjin. I caught a specimen at Varatic on August 1st, which was very light-grey in colour, and which exactly resembled two remarkably pale specimens from Amasia in Staudinger's collection. This form seems to occur in eastern

Europe and Asia Minor as a constant aberration of the summer brood, and is certainly sufficiently distinct to be called ab. *clarus* (Caradja).

Without actual examples one can hardly tell what this aberration is, from the description "very light grey in colour," exactly resembling "two remarkably pale specimens from Amasia." Is the ground colour grey, or is the grey due to surface scaling? It appears, however, to be possibly an aberrative form leading up to the eastern race, *sinina*, Gr.-Grsh. (see *infrà*).

ε. var. *popoviana*, Nordm., "Bull. Mosc.," iv., p. 443, pl. xii., figs. 3, 4 (1851); Alph., "Iris," vii., p. 303, *in part* (1894); Rühl, "Pal. Gross-Schmett.," p. 682 (1895); Tutt, "Brit. Butts.," p. 121 (1896); Staud., "Cat.," 3rd ed., p. 98, *in part* (1901). *Popovianus*, Staud., "Cat.," 2nd ed., p. 34 (1871).—Alæ integræ, ciliis immaculatis, limbo inter costas expresse albo-punctato, maculæ fasciæ mediæ alarum posteriorum supra et subtus minutæ, distinctæ et separatæ, cilia alarum anteriorum fusco-cinerea, posteriorum albida. This insect belongs to the *tages* section but, differs from that species. The ground colour is a dark grey-green, not grey-brown, as in *tages*, with the black and white areas sharply distinct. The fringes of the forewings are dark grey above, those of the hindwings pure white. The small but very distinct spots on the edge of the wings are limited by a deep black line on the outside; the white spots on the underside lie in an area of a very uniform dark grey-green ground colour. In the neighbourhood of Kjachta, captured by Herr Popoff (Nordmann).

Staudinger unites this variety with the *sinina* of Grum-Grshimailo, although the latter notes nothing of the grey-green ground colour stated to be characteristic of this form. For the convenience of students we have kept the two descriptions separate. Staudinger gives the combined distribution of *popoviana* and *sinina* as "Dahuria (south-east Siberia), Amurland, North China, Asia Minor (v.), eastern Nan Shan."

ζ. var. *sinina*, Gr.-Gr., "Hor. Soc. Ent. Ross.," xxv., p. 461 (1890-91); Leech, "Butts. China," p. 661 (1892). *Popoviana*, Alph., "Iris," vii., p. 303, *in part* (1894); Staud., "Cat.," 3rd ed., p. 98, *in part* (1901).—Alis supra et subtus pallidioribus, griseo atomatis, maculis submarginalibus albis, ceteris distinctissimis. Fimbria multo pallidiore. In montibus ad Dongar Aschen detectus (Grum-Grshimailo).

According to Staudinger (*Cat.*, 3rd ed., p. 98) this is the same as *popoviana*, Nordm., but Grum-Grshimailo notes nothing concerning the grey-green colour stated to be characteristic of *popoviana* (see *suprà*). Staudinger diagnoses it (*op. cit.*) as: "Alis punctis ante-marginalibus albis distinctissimis; alis posterioribus ciliis albicantibus." Alphéraky notes (*Iris*, vii., p. 303) that "this form has been taken in numbers by Grum-Grshimailo in the Sinian Alps, where it appears to replace the type. It is found rarely as an aberration in other countries, and he has, he says, before him, a very large and beautiful ♀ of this form, taken in Borjom, in Transcaucasia. It is probable that the specimens from Amurland, as well as those from Asia Minor, referred to by Staudinger (*Rom. Mém. Lep.*, vi., p. 219) are intermediate between the type and var. *popoviana*." At least the Asia Minor examples would appear to belong to ab. *clarus*, Car. (*suprà*). Staudinger says (*op. cit.*): "According to Bremer, Radde found this species on the Schilka and the Amur, where it is evidently local and rare. Herz discovered the insect sparingly in China, and these specimens are very different from the European examples, in that they have a conspicuous row of white spots on the underside. In specimens from Asia Minor these spots already appear to show distinctly." Leech says that these north Chinese examples, mentioned by Staudinger, appear to agree with the var. *sinina*, as described by Grum-Grshimailo, the latter collector having sent him specimens for comparison.

EGGLAYING.—On June 3rd, 1905, I spent some time in watching the ♀s of this species deposit their eggs, in a rough field outside Hazeleigh Wood. One specimen, particularly noted at about 12.30 (noon), fluttered low among the grass, settling from time to time on the flower-shoots of the hairy-leaved *Lotus uliginosus.* I did not notice her settling even once on the ordinary smooth form of the plant. Each time she alighted she deposited a single egg at the base of a leaf on its upper surface, squirming her body all round the flower-head, apparently with a view to discovering exactly the proper spot on which to oviposit. She displayed no timidity, but flitted along with the greatest unconcern. On June 13th another ♀ was observed, at 4.30 p.m., ovipositing on the ordinary *Lotus corniculatus*, in a field where *L. uliginosus* does not grow, thus proving that, in all probability, this species feeds on both plants (Raynor). The egg is apparently laid on the upper surface of a leaf of *Lotus uliginosus* and *L. corniculatus*, being fairly conspicuous after it has been laid a few hours, owing to the colour changing to a deep orange, recalling rather the tint and general appearance of the egg of *Euchloë cardamines.* It is laid on the very young leaflets towards the end of a growing point, and is placed either on the upper- or undersurface of the leaf, where, in spite of its conspicuous coloration, the folding of the leaf makes it somewhat difficult to see without a detailed search (Tutt, June 2nd, 1905). Buckler says: "The pale, greenish, pellucid eggs are deposited on the leaflets of *Lotus corniculatus.*" We have never seen green eggs of this species.

OVUM.—Pale yellow when laid, they soon become bright orange. When ready to emerge are greyer, with the black larval head shining through at top. In shape and sculpturing they have much in common with Vanessid eggs, and are half-way between domed and sugar-loaf in outline. They look taller than wide, but are not so, the width being 0·6mm., the height 0·54mm. This is owing to the tapering upwards, but partly, perhaps, to the fact that the width includes the ribs, which are high, and raised on a higher level than the hollows between them, in fact, if the width be taken across at the bottom of two hollows, it is almost the same as the height. The egg is widest about one-third up, thence it narrows a little downwards and tapers upwards, but is still nearly 0·4mm. wide very near the top, which is rather flat. The ribs are ten in some, eleven in other, specimens (ten counted in two, and eleven in three eggs), are very high and bold, almost like a piece set on the surface, 0·04mm. wide and 0·04mm. high; seen in profile it looks beaded along the top (a bead to each secondary rib), the bead being formed by a thickened arched margin, with a more transparent portion beneath; very transparent between the secondary ribs, so that a rib, taken sideways in a proper light, looks like a series of arches. They stand out even more prominently round the top; they do not, however, continue so boldly as a ring round the micropylar area, which is not very definitely marked off by a lower ribbing; it is about 0·14mm. across. The ten or eleven ribs diminish to about seven at top by joining or stopping short. The secondary (transverse) ribs are well-marked, one opposite each "bead" of vertical ribs, and about 0·02mm. apart; the hollows in which they lie are actually concave from side to side (Chapman, June 17th, 1905). The egg is somewhat dome-shaped, inclined, however, to conical in outline, being somewhat

more than a hemisphere, the height a little less than the diameter, the base somewhat rounded at the edges to the front of attachment, the apex somewhat depressed; pale yellow in colour, somewhat paler on the projecting parts of the vertical ribs when first laid, but quickly changing to a rich orange tint. It is conspicuously ribbed from base to shoulder by thirteen clearly defined, rough-edged, vertical ridges, which are reduced to seven from the shoulder to the edge of micropylar area, and fade somewhat towards the base. These ribs are crenulated and glassy in appearance, whitish-yellow in colour, owing to reflected light, and look quite pale against the deep orange tint of the egg; the ribs are all equally well-developed, the six ribs that stop short not failing gradually, but being cut off sharply at point of termination. The seven ribs, continued to micropylar area, form a slightly-raised rounded rim around latter, which is slightly depressed; the micropylar cells are circularly placed around a barely-raised micropylar centre, the cells decreasing in size from without to centre. The surface of the shell is shiny, and there is a distinct trace of a fine transverse ribbing between the vertical ribs, from base to micropylar area. The micropyle appears to form a tiny button at the base of the apical depression (Tutt, June 2nd, 1905).

Habits of larva.—The newly-hatched larvæ leave the eggs about the middle of June, and form little caves by drawing together three leaflets of *Lotus corniculatus* with glistening silken threads, each cave being made by the two outer leaflets being drawn almost close together (leaving space enough for the ejection of frass), the middle one being bent over them like a curved roof, so that the cave passes easily for a not quite expanded leaf. In these they live, abandoning them and constructing newer ones when needed, the young larvæ meantime feeding on the inner surface of the leaflets. They feed and grow fairly rapidly, eating away the whole thickness of the leaflets forming their caves, and, so soon as their ravages expose their bodies, they move off and form new habitations, the change always taking place at night, slowly and deliberately. Throughout July they continue to hide themselves, and early in August are fullfed, when they spin a silken hybernaculum, within which they pass the winter, resting quietly until early April (Buckler). Chapman observes that the very young larvæ make a small nest between several young leaflets, sometimes as few as two, which they spin firmly together; in the 3rd instar the larvæ make a nest of small leaves, little larger than themselves, lining it with a rather close carpet of silk. At all stages the larvæ jerk the fæces to a distance. Sich observes (*in litt.*) that he received, on July 15th, 1905, several larvæ from Dr. Chapman. They were in, or entering on, the third stadium, and feeding up well on *Lotus corniculatus.* They were, at first, kept in a tin box with sprays of the foodplant, but as they did not appear to exactly flourish, he placed some *Lotus* in a bottle with water, putting the whole in a soda-water tumbler, with the larvæ on the plants, and covering the mouth of the glass with muslin. In this manner they fed up well. Having some difficulty in obtaining a good supply of *L. corniculatus*, the smaller and generally smoother species, he tried the larvæ with *L. uliginosus*, the long sprays of which were more convenient to keep in water. This they took to easily, and later ate it in preference to the smaller species. Once the caterpillars were tried with *Trifolium repens*, but

they would not touch it. When feeding they never ate the flowers of the *Lotus* even when very hungry, but only the leaves, and the softer parts of the leaf-stalks. The larvæ were very inactive and could only be induced to move by touching the claspers with a moistened artist's brush. By this means they were transferred to fresh supplies of food. They generally bit savagely at the brush, but this was the only means of defence they ever adopted. They never everted the chin-gland. When placed on the fresh food they often ate a portion of a leaflet before spinning a new tent, but they always appeared very anxious to get under cover. The tent is made by drawing the three leaflets of a *Lotus* leaf together and fastening the edges with very strong silken strands. In the fourth and fifth stadia, and, perhaps also in the earlier stadia, the larva spins a silken platform on which it rests. This platform is not always on the floor of the tent, but sometimes on the ceiling. They always undergo ecdysis in the tent, and, as Sich does not remember to have seen a cast skin (though many cast heads), he thinks the larvæ must eat the old skin. In the fifth stadium they are too large to be effectually covered by one *Lotus* leaf, and they therefore make use of the leaflets of two or more leaves, forming a kind of ball of leaflets. It is astonishing how well these caterpillars are hidden. Their soft green colour, as well as their plump shape. adds much to their powers of concealment when living among the *Lotus* leaves. It is not always easy to see a larva when one knows that it is on a certain piece of the plant, and one fancies that, if it were of the ordinary cylindrical shape, it would be much more easily seen among the obovate leaflets of the *Lotus*. The larvæ rest in the tent with the head curved round to one side (either side), and, if disturbed, they tuck the head against the 3rd abdominal segment. In feeding, they stretch out of the tent only so far as is necessary to reach the leaves around. They keep the tent beautifully clean, shooting their excrement far away. One larva, noticed doing this, shot the pellet on to a window-pane thirteen inches away with such force that the pellet rebounded some inches. The pellets always seemed to be dry when excreted, and are caught on the teeth of the anal comb preparatory to being shot off. On July 23rd, all but two larvæ were in the fourth instar, and three days later the most forward specimen had entered the fifth and final larval stadium, which most of them reached by August 1st. Two of them noticed on August 5th, had grown very large and very stout, but were still quite green in colour. Ten days later the larvæ began to lose their green tint, getting brownish, and the spiracles became very dark. At the same time they began to shrink in bulk, becoming more wrinkled and only ate very sparingly. A few days later the larvæ were returned to Dr. Chapman (Sich). A larva kept by Buckler, left its hybernaculum at this time to make another retreat and then died; but it does not appear to be usual for the larva to leave the plant to spin a puparium, the hybernaculum generally serving for a puparium in nature. Chapman observes that, for hybernation, the larva likes to go to some distance from its foodplant, and selects a fairly dry place, probably amongst dead leaves, dry grass, or, where available, under stones. Of the larvæ under observation, some spun together dead leaves, others muslin, some paper, and one or two that escaped were found in odd corners, generally disturbed in discovery, but one had found a bit of dead leaf, and a bit of paper and drew them together. In all cases they appear to

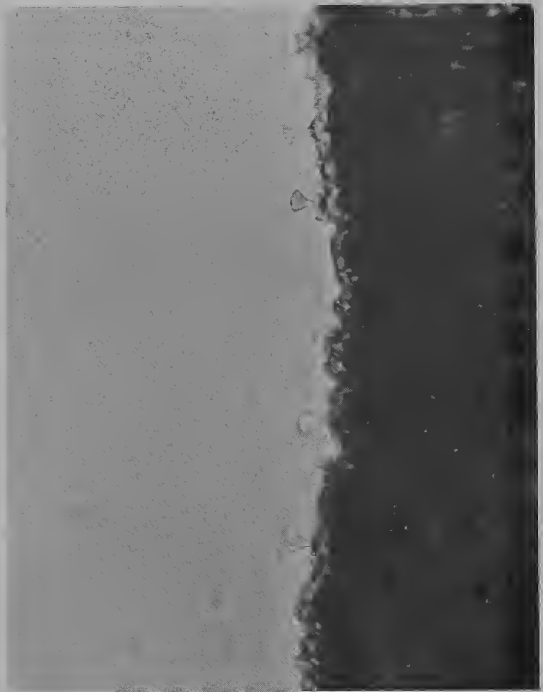
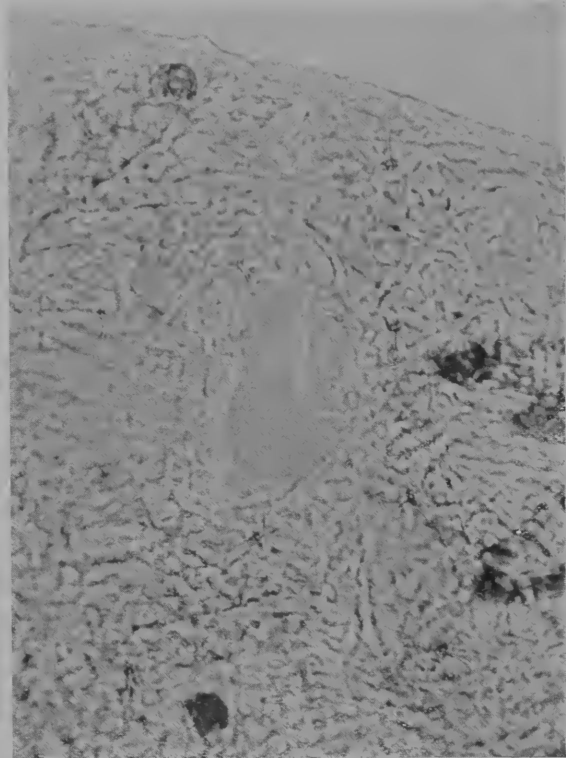


Photo. F. N. Clark.

1.
Clubbed hairs of larva of Nisoniades tages in the first instar × 200.



2.
Skin-surface of larva of Nisoniades tages in the first instar × 200.

prefer to get the material to form a complete enclosure, so that only the edges have to be held together, but it must often happen, naturally, that they fail in this, as they are perfectly prepared to close in the deficiency with a web of silk; one or two escaped larvæ had used this expedient, and two that were in pill-boxes spun in an angle, and the whole enclosure from bottom to side of pill-box was made of silk. This is of special pattern, being a network of which the bits are very dense, but it is full of more or less circular holes of various sizes. Unless disturbed in some way, the larva pupates in spring in its hybernating cocoon.

Larva.—*First instar* (newly-hatched): Rich red-brown in colour, with black head and prothoracic plate. [Comparing it with Scudder's figures (*Butt. New Engl.*, pl. lxxiii), it agrees in form with fig. 2 (*Thanaos lucilius*), and in the hairs, etc., of the prothorax, but the plate is black. The head agrees very closely with fig. 8 (*Epargyreus tityrus*) as to sculpturing and hairs; the hairs of the meso- and metathorax and of the abdominal segments also agree very closely with fig. 8, if we suppose tubercle iii to be omitted in fig. 8, on a dorsal view like this, it is to be detected with difficulty. In *tages* also, on the 9th abdominal segment, the posterior dorsal hair is a short club, like the other, not a bristle, and iii is present, but not iv; on the 10th abdominal are two clubs and two bristles on either side.] 1·7mm. long. Head black, minutely pitted, with fine minute clubbed solitary hairs at usual sites of tubercles; 8 on either side, regularly disposed, being easily visible on dorsal view. The prothorax is divided into several subsegments; the 1st has two dorsal (equally spaced) hairs on either side, the 2nd subsegment with no hair behind middle one, the 3rd with a hair behind outer one of 1st; behind these subsegments is a subsegment without any hairs; the prothoracic plate has four hairs on each side, two in line with i, and two with ii; the plate is divided into three transverse pieces, and hairs are, inner on the 1st and 2nd, and outer on the 1st and 3rd; lower down is a bristle. The meso- and metathorax have each two (equally spaced) hairs on either side of dorsum of the 2nd subsegment, also one marginal hair; one subsegment being in front of this and two behind, without hairs. The abdominal segments are divided into 5 subsegments, of which the first is the largest, and unites with the second at about the level of iii; the rest go down to the lateral flange; the 1st subsegment carries tubercle i, the 3rd carries ii, whilst iii and the spiracle below it are in about the line of division between the 1st and 2nd subsegments, which (as just noted) fails at this level; below the spiracle is a faint flange, then a more marked one carrying iv and v, the latter fractionally the higher, and close to front of segment; the 9th abdominal segment shows two subsegments, the 1st carrying the setæ of i (?), the 2nd, ii and iii (?), and a lower one v (?) where the subsegmentation ceases; the 10th abdominal carries one clubbed hair dorsally, one laterally, with three marginal (ordinary) hairs on each side, behind, on the flange. Seen from above, the setæ arising from iv and v form a fairly regular marginal row round the larva. The hairs arising from all these abdominal tubercles are really short glassy clubs (*see* pl. vi., fig. 1); the little clubs seem wrinkled at their thick ends, they are only a few times longer than thick, except those on iv and v which are longer, perhaps 0·02mm. long, and are more definitely knobbed hairs. They average about three times as long as

broad, and are much the larger at their distal ends; their surface rough or spiculate.* The sparkle of the little crystal hairs on the brown larval skin, in a bright light under a glass, is remarkable, and seems quite out of proportion to their small size, in some lights they are seen merely as dark dots. The skin surface is minutely dotted with darker skin-points; these appear to be minute longitudinal raised ridges, rather than points (*see* pl. vi., fig. 2). The true legs are of the same colour as the larva, short and thick; the prolegs have about 20 black crochets in a circle, so complete that it is difficult to say it is broken anywhere; of the crochets, three on posterior margin are more than twice as large as the others. No trace of lenticles detected. [June 29th, two are now quite fat in this instar, so that the body is much thicker than the head, and there is no definite neck.] *Second instar:* Length 3mm. Head black. Body snuff-brown with numerous black skin-points. The hairs on general surface numerous, white, glistening, and in the sunlight sparkle like diamonds; they are colourless, very short and clubbed, pear-shaped (attached at stalk end), with indications of roughnesses or spiculations; length about 0·03mm., and of width about 0·014mm. At probable situation of tubercle i is a hair-base without a hair (? lenticle). Behind the anal plate are ordinary hairs. There are five subsegments to each segment, and they bear the relative widths of 3 : 2 : 1 : 1 : 1; the 1st of these shows two rows of these glistening hairs, 11 or 12 being visible on either side in a dorsal view; the 2nd has one row of 4 hairs, the 3rd one row of 5 hairs, the 4th one row of 5 hairs, and the 5th is without hairs. *Third instar:* Head large, black, almost exactly 1mm. in diameter, finely, closely, and irregularly pitted; the margin between the pits rather sharp; the head covered with abundant fine, white, feathery hairs; according to light and aspect these are sometimes invisible, at others, make the head look quite hoary. Neck, 0·6mm. long, at middle 1·0mm. or over in width, according to development. It is now a short thick larva, 5·0mm. long; greyish-ochreous; subsegmentation as before; hairs now numerous, very short, consisting of a minute club and a stem no longer than diameter of club; hairs still white and glistening, the club apparently rough. Some bristly hairs round the hind margin of 10th abdominal; the dorsal lenticles in same positions as before, are now, relatively, a little smaller, and are annular, like spiracles. *Fourth instar* (newly-moulted): Length only 7mm. long; head, a little over 1mm. in diameter; black, and as in third instar; neck 0·7mm. long, at thickest part 1·3mm. wide. Body green, with a darker dorsal line and well-marked subsegmentation; each segment with five subsegments, relatively $3\frac{1}{2} : 1\frac{1}{2} : 1 : 1 : 1$ in width. The glistening, short, clubbed hairs are much as in last stadium; they form a little circle round the dorsal lenticle on the 1st subsegment (? tubercle i); dorsally on the 2nd subsegment are two, one in front of each other, but, on the rest of this and the three following subsegments, they are in single file; on the 1st subsegment they are irregularly scattered (but almost symmetrical) rather than in two, three, or more rows. The lenticles on the

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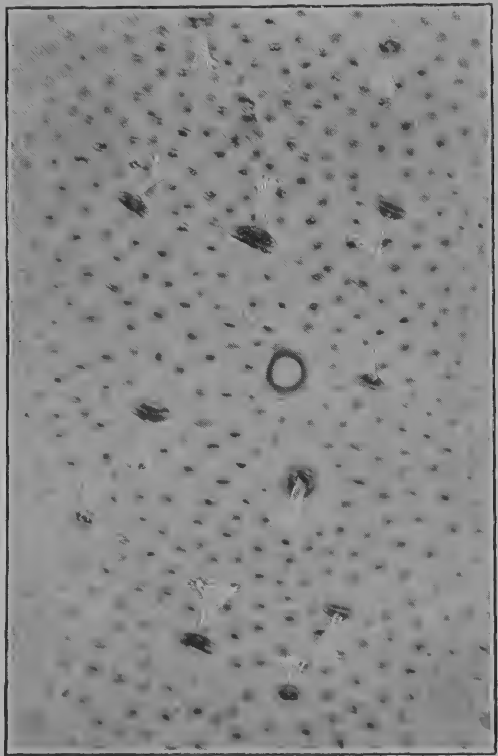
* In the second and following stadia they are more numerous, and no longer identifiable as tubercular; relatively smaller, but actually about the same size. In the third and fourth stadia, they become definitely trumpet- or calyx-shaped, but in the last skin all the numerous minute hairs are quite ordinary in their form (*see* plate vii).

prothorax are—one in the centre of each side plate (which is of same colour as rest of larva, but differently sculptured), one in front of (and above) spiracle, one below (and in front of) spiracle; the mesothorax has the two last described of these; the metathorax has a dorsal one also, and an additional one behind the second. On the abdominal segments the lenticles are the same, but the 2nd is often wanting, and on the 1st and 2nd abdominal segments are two large ones, one above the other, lower down, and in line with the spiracle. The small hairs are trumpet-shaped, as in pupa of *Chrysophanus phlaeas* (Chapman). *Fourth instar* (full-grown): Length 12mm.; width of head 1·7mm. Head very large, suture deep. Colour black, with two small greenish spots on the crown. The head is covered with raised lines or ridges, forming cells of very irregular shape. In each cell, one, two, or even three, small, black tubercles are present, each carrying a soft white hair, plain on one side and serrated, or perhaps better described as plumose, on the other. On the head are also several much longer, stouter setæ, ending in a sharp point, and rising from larger tubercles. Prothorax narrower than the head, and consists of four? subsegments. The prothoracic shield not very conspicuous, divided by a mediodorsal line, and also by a transverse crease. It carries two dark-bordered circular lenticles and numerous warts, each bearing a glassy-looking seta, expanded into a cup at the apex, with a denticulated border. Below the shield is another lenticle, and immediately below this is a wart, which bears a very long hair-like seta (0·3mm.). Below the wart lies a third lenticle, and behind this the very large oval ochreous-brown spiracle. Between the spiracle and the leg is a fourth lenticle. The lenticles of this species have a raised, deep, black, shining border, with apparently a flat diaphragm-like plate below. They remind the observer exactly of a microscopical shellac cell, with the cover-glass in position. The meso- and metathorax have four subsegments; the mesothorax is furnished with a lenticle on the dorsum not far from the mediodorsal line, a lateral lenticle below this, and a third on the flange. Behind the lateral lenticle is a wart with a very long hair (seta). The metathorax is similarly furnished, but the wart and long hair (seta) are absent, and a second lateral lenticle takes their place, so that there are two lateral lenticles on the metathorax, one behind the other, and below these the lenticle on the flange. The 1st and 2nd abdominal segments have five subsegments, the 1st larger than the rest. On the 1st subsegment are the two dorsal lenticles, one on each side of the mediodorsal line. On the 2nd subsegment is the ochreous, rather elevated, spiracle, with a lenticle above it. Below the spiracle, on the flange, are two lenticles, one behind the other. Below these, on the venter, are four lenticles, arranged in two pairs, each pair occupying the space on which the clasper would grow if these segments bore claspers. The 3rd abdominal is similar, but the claspers take the place of the two pairs of ventral lenticles. The 4th to the 8th abdominals are also similar, except that the prespiracular lenticle on the flange is absent. There are no ventral lenticles either on the 7th or 8th abdominal segments; the 8th has three subsegments, and the 9th two. The 9th carries the dorsal, lateral, and flange lenticles, but the 10th only the dorsal lenticles. On the posterior wall of the anal claspers is a large pale orange wart, without hair or seta. The whole skin of the larva is covered with a clothing of black spicules, and

there are numberless dark warts, perhaps thicker on the ridges of the subsegments, scattered everywhere over the surface. Each wart on the dorsal and lateral areas bears a pale, short, stout, glass-like seta, expanded at the apex into a funnel with a puckered margin. Some of these warts and their setæ are larger than others, and among the larger ones I believe I can distinguish the primary tubercles i and ii. In the ventral area the warts carry each a rather long, sharply pointed, seta. In general shape the larva is very stout, and of a hairless, though wrinkled, appearance. The prothorax forms a kind of neck. The stoutest segments are the 3rd, 4th, and 5th. There is a strong lateral flange. The thoracic legs are rather small, pale ochreous, and almost translucent. The abdominal claspers of moderate size, pale green, with a complete circle of brown hooklets, apparently in two rows. The colour of the body is pale greyish-green. The dorsal vessel gives a dark green mediodorsal line, and there are faint pale subdorsal and spiracular lines. *Comparison of fourth with fifth instar:* Besides the great difference in size of the larvæ when in these instars there are two other marked distinctions. The head in the fifth instar is marked with pale patches, which gives it an ochreous appearance, not a black aspect, as it has in the fourth instar. The most marked and essential difference, however, lies in the formation of the setæ on the dorsal and lateral areas of the larva (see pl. vii., figs. 1-3). In the fourth instar these setæ are short and clubbed, or cupped at the apex, in fact, so widely are some of them expanded at the apex that the seta might almost be described as funnel-shaped. In the 5th instar the setæ of these areas gradually run to a point, and may be described as curved spines. *Fifth instar:* Length, at rest, 19mm.; outstretched, 22mm.; width of head, 2·5mm. Greatest width of body (3rd abdominal segment), 4mm. In general aspect the larva is short and very stout, rather pointed at the posterior end, very flat beneath, with a strong lateral flange. The head, owing to the remarkably small prothorax, appears large. Both the legs and claspers are rather small. Colour: Head blackish-grey, with six pale brown blotches, usually arranged as follows:—On each cheek, near the suture, is a crescent with its convex side towards the suture, the cusps are very pale; above the black ocelli is a somewhat triangular spot, and another similar spot just between the ocelli and the labrum. The lower part of the labrum is conspicuously pale. The body is soft greyish-green, showing a yellow tinge where the skin is folded, and on the 10th abdominal segment. The anterior portion of the prothorax is paler than the general area on account of the absence of the black spicules. The dorsal vessel is very conspicuous as a thin dark line. A subdorsal whitish line runs from the prothorax to the 10th abdominal segment. There is also a slender, but less distinct, pale spiracular line. The spiracles are pale buff. Thoracic legs ochreous with black tips, while the ventral and anal claspers are greyish-green with brown hooklets. The head of the larva is heart-shaped, the suture well-marked, but the clypeal borders not very distinct. Form: When viewed from above, at rest, the head of the larva appears large, wider than the prothorax, which is small and narrow, but the mesothorax is wider than the head, and the metathorax rather wider than the mesothorax. The larva increases in width rather suddenly to the 3rd abdominal segment, the 4th and 5th about equal to the 3rd, the 6th a little



1.

Trumpet-shaped hairs of larva of Nisoniades tages in the fourth instar, with lenticle, and skin-points × 200.

2.

Hairs of larva of Nisoniades tages in the fifth (last) instar, with lenticle × 200.

Phot. F. N. Clark.

3.

Hairs of larva of Nisoniades tages in the fifth (last) instar, with lenticle × 100.

narrower than the 5th, the 7th narrower than the 6th, the 8th much narrower than the 7th, the 9th and 10th about the same width but narrower than the 8th. The 10th segment is bluntly rounded. When viewed in profile the dorsal outline of the larva is highest on the 4th abdominal segment, whence it slopes quickly, but evenly, down to the 10th abdominal segment on one side, and to the head on the other, but it drops suddenly at the prothorax, as if this segment had slipped down out of place. The prothorax appears to consist of four subsegments, the 1st and 4th being very small. The meso- and metathorax have each five subsegments, the 2nd and 3rd of which are larger than the other three. The 1st to 6th abdominal segments have each five subsegments, the 1st being very large, while the 2nd is only a little larger than the three following. The 7th abdominal has but four subsegments, a large, a moderate, and two small ones. The 8th has three, a large first, smaller second, and smallest third; while the 9th has two small subsegments. The 10th consists of the long and much wrinkled anal flap. The head is covered with deep pits, of very irregular size and shape, surrounded by highly raised borders. In the pits are small black warts, each with a single soft pointed seta, plain on one side and slightly serrated on the other. There may be one such seta or four, or even more in the same pit. There are also several longer and stouter hairs, which rise from larger tubercles. On the clypeus near its apex is a pair of small lenticles, similar to those on the body of the larva, and another pair lower down and wider apart. Most of the dorsal area of the prothorax is occupied by the thoracic shield. This is divided by a mediodorsal line and, also transversely, by a deep crease, which, however, terminates before reaching the lateral borders of the shield. On the shield are numerous dark warts, each with a short, stiff, sharply pointed seta. On each side of the mediodorsal line, and not far from it, the shield bears a rather oval lenticle, and there is another near the lateral termination of the shield, and a third below on the edge of the shield. Below this latter is a small wart bearing a very long hair (seta) (0·5mm.). Below the shield lies the very large ochreous spiracle with a lighter ochreous margin. Between the spiracle and the leg is a fourth lenticle. The lenticles of this instar resemble those of the fourth instar, being fairly circular, ochreous, with a broad, shining, black, raised border. Beneath, just in front of the legs, the large chin-gland is situated, and appears as an oval swelling with a deep transverse depression in the centre. The dorsal lenticles on the mesothorax are absent, but there is a subdorsal lenticle. Behind this is a wart which carries a very long hair, similar to that mentioned as occurring on the prothorax. Perhaps this is the primary tubercle iii. Another lenticle is situated above the legs. The metathorax has a pair of dorsal lenticles on the 3rd subsegment, one on either side of the mediodorsal line. Below these is a pair of lenticles side by side. It looks as though the posterior of these two represents the wart with the long hair of the mesothorax, for that wart is not present on the metathorax. There is a lenticle above the leg. The 1st abdominal has the pair of dorsal lenticles on the 1st subsegment, while the lenticle above the spiracle is on the 2nd subsegment, the spiracle itself lying between these two subsegments. Below the spiracle, on the flange, are two lenticles, one behind the other. Beneath the larva are four lenticles arranged in

two pairs transversely, each pair occupying the site possessed by the legs on the metathorax. The 2nd abdominal is similar, except that there is sometimes only one (the anterior) lenticle on the flange. This second flange lenticle on the 2nd abdominal is an inconstant quantity, a larva will sometimes have it on one side but not on the other side of the body; in fact, a larva commonly has one or two normal lenticles missing. The lenticles on the 3rd to the 8th abdominals are similar, that is, on the 1st subsegment a dorsal pair, on the 2nd subsegment one above the spiracle, and one below on the flange, six in all. The 9th abdominal has the same number. I believe the 10th abdominal has a pair of dorsal lenticles, and there is one lenticle on the outer wall of each of the anal claspers. On each anal clasper, above the hooklets, on the posterior wall, is a large orange tubercle, terminating in a blunt point without any seta. The anal claspers have two or three rows of hooklets, but the circle is not complete, there being a gap in the outer posterior quadrant. Beneath the anal flap the teeth of the anal comb are visible. The skin of the larva is everywhere covered with small, blunt spicules, and also bears a fairly thick coating of small, dark tubercles, each crowned with a short, stout, sharply pointed seta. These secondary tubercles are more numerous along the ridges of the subsegments and the flange, and also around the claspers. They are of two sizes, the smaller bearing a seta about 0·06mm. long, and the larger a seta about 0·1mm., but there are also intermediate sizes. As in the 4th instar, there are, among these larger tubercles, some which I believe to be primary tubercles, of which I think I can distinguish i, ii, and possibly iv (Sich). *Final instar* (fullgrown): About 23mm. long and 4mm. wide from about the 2nd-5th abdominal segments. The larva is fusiform, tapering similarly to both extremities, with the exception that the head is added to the anterior extremity. The head is about 2·8mm. across and 2·7mm. high, measuring into the notch dorsally, but 3·0mm. if measuring the lateral eminences; whilst the "neck" is only 1·8mm. wide and 1·7mm. high. The colour is green, overlaid with a brownish tint, which gives a dirty-olive colour, most marked in front, least about the middle segments. The head is deep brown, with paler (terra-cotta) in certain regions, but varying in amount, and shading into the ground-colour; on either side is a large patch on the vertex, one laterally, and two beside the clypeus, one about the centre of the face, the other lower. The labrum and jaws darker. The spiracles dark brown, a green dorsal line (dorsal vessel) and a pale line half-way between this and the spiracles. The head is rough with minute raised ridges; it is covered with hairs, mostly very short (ochreous); each of these arises from the bottom of a pit, or from a slight eminence at the bottom of the pit. These pits are closely crowded together, and are of slightly varying sizes, and slightly varying closeness, so that the ridges between them are only approximately circles and parts of circles, and are always rather sharp; these are the ridges that make the head so rugged in surface; they form an excellent defence against the hairs being rubbed off. The legs are pale ochreous, the prolegs green, as the rest of the skin. The segments present a marked flange some way below the spiracle, and a rounded boss on each segment (3rd member of lateral flange) just above prolegs. There is no trace of an upper lateral flange at spiracular level. The segments are markedly divided into subsegments.

On abdominal segments there are five, whose length is respectively as 4:2:1:1:1. On the first, at position of i, is a distinct black circle (lenticle), which may actually represent i; there is no indication whatever of ii, except on some segments, in rather stronger hairs; but iii may be represented by a lenticle at approximately its usual position; iv and v are apparently represented by two black circles, rather close together and close to spiracle, these, like the others, are small, but typical lenticles. Below these at a little towards the front of the segments (approximately vi) are two lenticles close together, and one above the other. This last pair, however, only exist on the 1st and 2nd abdominals, and iv and v (?) fail by the time the 5th abdominal segment is reached, one or other only existing (if any) on the 3rd and 4th abdominals. On the prothorax is a plate, of the same colour (green) as the rest of the larva, with a median suture and a transverse suture or groove, nearer the posterior than the anterior margin. At the end, this curves forward and has a brown pigmented patch, and at its extreme end is a small lenticle, a rather larger one near middle line. The front portion (on each side) carries about 45 hairs, the posterior 20; these are very minute, on brown bases, and disposed in several irregular rows; half-way between the spiracle and leg is another lenticle. The mesothorax appears to have three subsegments, equal to about 3:2:1 in relative widths. There is a lenticle in line with iii, and one near base of proleg, but one or both of these is often absent, even on one side and not the other. The metathorax seems to have three subsegments, or five, if the division of 1st and 3rd into two are included as primary; the incisions are less marked than the others, but they mark off the hairs into sections. Reckoning five, they would measure 1 : 2 : 1 : 1 : 1; the 3rd carries lenticles in line with i. There are a pair side by side in line with iii, and another towards leg. The whole surface is covered with minute hairs (about ·14mm. long), colourless, arising from black points (see pl. vii., figs. 2-3). These hairs are remarkably wide at their origins and proceed rapidly to a sharp point, with a slight curve. The basal width suggests that they ought to be four or five times their length. They are in one row on the narrower subsegments, but on the wider are irregularly disposed, but might be regarded as in two to six rows, according to width of subsegment. They are about ·15mm. apart in the single rows. The skin-surface is closely covered with sharp points on stellate bases, the points are less than 0·02mm. apart. The prolegs have nearly complete circles of crochets, there is a gap on the outer posterior aspect of about 30°; in one example, one leg shows some chitinous points across this. The outer side has 14 or 15 crochets in single line. These are, apparently, continued round the inner aspect, but are supplemented by a series of about twice their length. These number about a dozen, smaller at each end of the row; it is not very definite where they end. In one specimen, one proleg has a circle a little more than half the usual diameter, and with only a single row of rather small crochets, though these are rather larger on the inner margin (apparently, a regenerated limb). The anal claspers are horseshoe-shaped, with the opening backwards, the crochets are in double series throughout, but more markedly internally, or more accurately, perhaps, those of the larger series are of greater size on that side of the curve. The anal plate is triangular, about 1mm. across, of the same colour as the rest of larva, except that it has a few brown dots that are not hair-bases, but are of about the same size as they

are. It carries hairs much as the surrounding skin does, both as to their number, size, and irregular distribution. It is, however, of a somewhat corneous texture and wrinkled on a larger pattern than those of the head. Beneath the plate is the anal comb, about 0·6mm. wide, and the same in length; the central spines are about that length to the number of some 13; these appear to be laterally flattened, and with five or six terminal crenulations, the extremities of divisions into which it tends to split. At either side the long central spines decline gradually into smaller ones, and the base of the comb becomes narrower, the last spine, sharply pointed, is not so very different from some rather large skin-spicules that are adjacent. The total spines are 21 in one specimen, 27 in another. At the extreme anterior margin of the prothorax, medioventrally, is a minute "chin-gland" (Chapman). *Final instar* (July 31st, 1868): 18mm. in length, with the back a little arched, and the belly rather flattened, being just of the same form as when younger; the body is very plump, and thickest in the middle segments; the segmental folds distinct, each segment subdivided into five subsegments, the broadest one in front; the head is somewhat heart-shaped and flattened on the face; the colour of the body is of a rather more yellowish-green than before, the minute, raised, points blackish, the dorsal line a darker green, and the paler subdorsal stripe delicately edged above and below with a fine faintly darker line; the anterior pair of tubercular dots just perceptible on each segment, but only with a strong lens; the spiracular region forms a slight ridge of paler whitish-green, the spiracles very small and red in colour; the head is purplish-brown as before, but with the addition of an ochreous streak from the crown down the front of each lobe, united below by another broad transverse streak at some distance above the mouth, and also a spot of the same colour on each cheek (Buckler).

Foodplants.—*Lotus corniculatus* (Buckler), *L. uliginosus* (Sich), *Iberis pinnata* (Donzel), *Teesdalia nudicaulis* (*teste* Lambillion), *Eryngium campestris* (Schiffermüller), *Coronilla varia* (Koch).

Puparium.—Unless disturbed in some way, the larva pupates in spring in the cocoon it has made for the purpose of hybernation. In one instance there was a branched V-shaped cable drawn across the thoracic region, as if intended for a girth, and the cremaster holds to silk that may have been recently spun; but, with these exceptions, there was no proof that any additions were made to the hybernaculum before pupation. On March 8th, 1906, some larvæ that have been in a warm room for a considerable time are still larvæ, but three are found to have pupated (Chapman, March 8th, 1906). The remainder of these pupated soon after. One larva, however, which was sent last autumn from Hyères, was kept on a mantelshelf all the winter (at Reigate), at a temperature of 70°F. and over on most days, and, its hybernaculum being transparent, it was often seen to move within it. English larvæ kept cool all the winter till the end of February, and then brought into a warm room, all pupated, as noted above, by about March 15th; whilst this southern one (carried south to Hyères again in mid-March) only pupated on April 10th. About March 30th it opened one end of its winter cocoon, as a provision for the emergence of the imago, but did not come out. The head of the pupa faces this opening, and there is, inside the cocoon, a girth; really, this consists of two strands drawn across the cocoon, one on each side of the pupa, and attached to

each other ventrally, making the girth seem to be the wrong way up (Chapman. April 12th, 1906).

Pupa.—The pupa in general outline is very similar to that of *Hesperia malvae*, but with more of the Sphingid curve (like that of *Sesia stellatarum*). The dorsum is hollow from the mesothorax to the 6th abdominal; the venter prominent at the ends of the appendages, but hollow opposite metathorax. Length 15mm.—10·5mm. to end of appendages, 4·5mm. beyond. Seen dorsally, front very flat. A line across the front of eyes is 2·7mm., and the central portion of the curve in front of this is only about 0·6mm. in advance of this line; behind this, for about 1·2mm. the width is unchanged, then it widens for about 1mm. to 4·00mm. at wing-spine (merely a rounded fulness); it maintains this width to the 2nd abdominal segment, from which it widens to 4·5mm. at end of 4th abdominal segment (9mm. from front), thence it tapers increasingly (making a curved margin) to end of cremaster. Seen laterally, the "Sphinx curve" is the dominant feature. When at rest, the dorsum is nearly straight from the 1st to the 5th abdominal; from this point the dorsal line slopes down to the tail-end, but so much less than the ventral line, that a longitudinal axis of the pupa (estimated) would have the end of the cremastral spine above it by half the distance to the dorsal line (of front abdominal segments). This dorsal line, carried forward, would have the top of the mesothorax about 0·6mm. above it, and would reach the surface again a little behind the front margin of the mesothorax. About 2mm. of the ventral line, behind the face, would be about parallel to the dorsal line (of abdominal segments). Thence it swells out to about middle of 3rd abdominal segment, and thence retires again to end of appendages, and continues the same curve, pretty uniformly, to end of cremaster. The antero-posterior diameter of the pupa, at different points, would be about 2·8mm. at thoracic spiracle, 3·5mm. at middle of mesothorax, 3·8mm. at 1st abdominal, 4·1mm. at the middle of the 3rd abdominal, 3·4mm. at the end of the 4th abdominal segment. The pupa examined is not, perhaps, quite mature, so the colours may yet deepen somewhat. The head and thorax with appendages look blackish, but, on examination, are seen to be a very deep green, with a good deal of transparency (or translucency), the abdominal segments a light reddish-brown. The whole pupa is shining and polished, so that one is hardly prepared to find that (except appendages) it has a tolerably abundant coating of very short pale hairs. The centre of the eyes, and some other portions, are paler green, a notable feature (in colouring and form) is the cover of the prothoracic spiracle, which is quite black, and, when taken in profile, stands out from the smooth surface as a black cone about 0·2mm. high; from the front it is more like a square epaulet. On the head and thorax one cannot say that the hairs have any special arrangement, but, on the abdomen, there is a very definite row at the line marking off the intersegmental subsegment, substantially, but not quite, the posterior border of the segment; then there is another row across, approximately, the middle of the segment, this one is less regular, and has other hairs near it, but hardly of it. It is most definite latero-dorsally. There are other more scattered hairs that can hardly be interpreted as a row anterior to this. Ventrally, the hairs are very minute and few, very nearly obsolete. The curvature of the glazed eye is directed almost exactly forward, and the extreme front

of the pupa is the base of the labrum. The labrum is triangular, apex pointed, the mandibles rounded, hardly meeting in middle line, being separated by the narrow diamond of labium which divides them and the extreme bases of the maxillæ. Basally, the maxillæ are very wide; they reach the end of the wings, and just project beyond by their conical termination. The second legs reach the eyes. The first legs end at 5·5mm. from the head-end of pupa, the antenna at 7·5mm., and the 2nd legs at 8·2mm. All the appendages have a little transverse wrinkling, but it does not interfere with their polished appearance, the wrinkling being fine waves and not ridges. The neuration of the wings is indicated by raised ribs, but is a little obscure. "Poulton's line" is obvious; the region beyond it is smooth and whitish, narrow at the anal angle, nearly 1·0mm. wide towards the apex, and even a little more if taken diagonally to the actual apex. The cremastral spine is small and rounded, about 0·5mm. wide, and 0·6mm. long. The cremastral hooks are scattered over its sides and end, those at end are so twisted in silk as to be difficult to see, let alone count, but are probably not more than ten or a dozen, if as many. They are about 0·25mm. long, with a smooth shaft and a large flat circular end made by the curling round of the hair. One such hair occurs half way up the cremastral spine, and there are several abortive ones scattered about it, some with hardly a trace of a hook, and one or two like fine cork-screws. In the living pupa, the dorsal head-pieces are not marked off by similar sutures to those separating the other parts, but by a delicate line, looking white in some lights, never dark like the others. The living pupa only presents the usual two (5th and 6th abdominal) free segments, notwithstanding that, on dehiscence, other incisions open as if free, notably those between the pro- and mesothorax and the 7th and 8th abdominal. The genital areas form, in front, a horseshoe-shaped projecting rim on the ventral aspect of the 10th abdominal. In the ♂, the 9th abdominal segment has a single transverse elevation; in the ♀, is apparently no elevation, but the two small linear pits seem to be on the 8th abdominal segment, all divisions between the segments being smoothed out. On the dorsum of the 9th abdominal segment of a male pupa is a curious longitudinal incision (March 8th, 1906). *From a dehisced and mounted pupa:* The maxillæ (together) are 2·5mm. across (at about 1mm. from their anterior angles), their upper ends, above this point, form, approximately, a semicircle; at this point, each forms a right angle, the upper (curved) edge being against the face, the lower (outer) margin against the 1st legs; thence they narrow rapidly, so that, at 1mm. lower, both together are 1mm. across; they continue downwards for 10mm. in all, and terminate between the ends of the wings. A small scrap of labium appears between their upper ends. The 1st and 2nd legs both abut equally against face and eye, the 1st, therefore, not touching antenna. It has a length of 4mm., ending, therefore, half-way down the maxillæ, the 2nd ends 2·5mm. further. The antennæ reach nearly the same point. The ends of the maxillæ, of 3rd tarsi, and wing-apices, appreciably project beyond posterior border of 4th abdominal segment. The eye-covers are large, the "glazed" portion is dotted very finely with minute points in radiating rows, the central rough portion carries a good many fine hairs. The dorsal headpiece is a small slip, 1mm. long transversely, 0·2mm. at widest longitudinally, that remains fixed to the front edge of prothorax.

The way in which the prothorax, on dehiscence, remains attached to the mesothorax is remarkable. It is a piece about 1·6mm. across, and 0·6mm. from back to front, square at dorsum, but sharpened to a point, like the prow of a boat at the outer end. When dehisced, the intersegmental membrane is quite a substantial plate, folded down the middle; the two portions, flat against each other before dehiscence, open out, each portion about 0·4mm. wide, but the folds do not quite straighten, so the pro- and mesothorax separate to something less than the possible 0·8mm., but are held firmly together. The spiracle-cover on the mesothorax is a large black knob, about 0·4mm. in diameter, covered with very closely-set crowded hairs, very short and thick; giving rather a velvety appearance. The dorsum of the mesothorax, as well as the prothorax, and, in fact, the rest of the pupa (appendages being only excepted), carries a fair number of fine transparent hairs about 0·12mm.-0·18mm. in length. Across the posterior portion of the mesothorax is a moderate number of transverse ridges or wrinkles (little more than microscopic), and the hairs are, to some extent, along these. On the mesothorax, these fine ridges are a marked feature; they are narrow, with parallel sides, and, in many cases, curve forwards in regular waves, so as to leave little hollows behind them, in which the hairs arise; in some cases, there is a fainter ridge close behind the other, which curves backwards at the hairs, leaving the hairs in a little oval space between them. The hindwing is narrow, and, passing the 1st and 2nd abdominal segments, ends just before the spiracle on the 3rd abdominal. The 1st abdominal segment has hairs and ridges like the metathorax; except along the posterior border of the segment, the ridges are ill-developed, though, at many of the hairs, the two ridges bending round, one in front and one behind, are specially distinct, and have the appearance of two eyelids with the hair as the eye. An attempt to count the hairs on this segment makes them nearly 40 on one side. They are most numerous in the middle and at the posterior border of the segment, and are decidedly fewer dorsally than laterally. The 2nd abdominal segment is similarly ridged, the ridges being more conspicuous along the anterior border of the segment, and the hairs more nearly in transverse rows. The spiracle has a fine series of arched ridges passing round it from the wing-margins above and below, with the usual appearance, as if the wing had pushed the spiracle backwards, and, in so moving, it had wrinkled up the surface in front of it. The 3rd abdominal segment is much the same, except that the ridges are less distinct; the hairs are few dorsally, and look as if there were two rows towards the front margin, another row medially, rather irregularly disposed, with two posterior rows, one marginal, the other a little forward of the margin, but a closer scrutiny shows hairs that would mean twelve rows if each hair was in a row, so that the five rows noted are only those where the hairs seem to fall most in regular line. On the 4th abdominal segment the spiracle is clear of the wing, and without puckerings. Here, also, the hairs are an anterior, a middle, and a posterior set, each approximately in two rows, but with other hairs elsewhere, representing nearly obsolete rows; some of the posterior hairs are on the intersegmental membrane. There are no distinct ridges, but there are many minute raised circles (or ovals), almost like hair-bases, but without hairs. These are more numerous and more in transverse lines towards the front of the segment (Chapman).

Dehiscence of pupa.—On dehiscence the eye-cover remains attached by filmy threads to the dorsal headpiece, and is quite separated from all other parts. This contrasts very much with, say, *Urbicola comma*, in which the eye-piece remains fixed between the face-piece and the maxillæ, and all attachment to the dorsal headpiece is ruptured. In this respect, *Urbicola comma* is practically of ordinary obtect character, whilst the habit in *Nisoniades tages* is exactly that of typical incomplete (or micro) pupæ (Chapman).

Time of appearance.—The species is single-brooded in the British Isles and the northern part of Europe, occurring in May and June, except for a few examples that appear as a partial second-brood in very hot summers, *e.g.*, 1893, in late July and early August. In Scandinavia, however, the single brood often extends from June into July, and, in the mountains of central Europe, too, the species also seems to be single-brooded, appearing in June and July, whilst in southern France, Italy, etc., it appears to be regularly double-brooded in April-May and July-August. Caradja says that it occurs in two, or even three, generations between May and September in the Haute-Garonne, but one suspects that there are rarely more than two broods, even under the most favourable conditions, although such records as May until September in Tuscany (Stefanelli), and February to September in the Barcelona district (Martorell), leave matters uncertain. As to its double-broodedness, we note that, at Wiesbaden, it is abundant in May, a second partial brood appearing in July (Prideaux); in Prussia, it usually occurs from early May to mid-June, but, in warm seasons, is double-brooded, occurring in April-May, and again in August (Speiser); occurs in April-May and again in July-August, in Baden (Reutti); in May-June and August-September, in Belgium (Lambillion); May and June in the Pont de l'Arche district, but as early as April 11th, in 1893, and again in August (Dupont); double-brooded in the lower parts of Switzerland, April-May and again in July-August (Frey); although Muschamp says that the second brood is much less abundant than the first in the Geneva district. It is also double-brooded in Austria, *e.g.*, in Bohemia (Nickerl), Lower Austria (Rossi), Salzburg (Richter), the Carinthian Alps (Zeller), and the Wels district, in April and again July-August (Brittinger); whilst, in Roumania, a brood in May and another in September are noted (Fleck), and, in Lombardy, May and June, and again August, rare (Turati), are recorded. We have ourselves found second broods at Susa, Torre Pellice, Aosta, etc., in Piedmont, as well as Grésy-sur-Aix, and several other localities, in Savoy and Dauphiny. It is possibly double-brooded in Greece; the first brood was taken in May at Kalávryta (Fountaine). In the high Alps, June and July are the usual months for the appearance of the single-brood, *e.g.*, middle to end of July on the Prenj mountains, late June in the mountains of Bosnia and Hercegovina, early July at Pontresina, late June at Andermatt. The following dates will give a good idea of the variation in the time of appearance, both at home and abroad. Continental records.—May 14th, 1865, in the Riedt, near Wallisellen (Dietrich); June 15th, 1886, at Andermatt (Jones); August 9th-12th, 1872, near Lucerne (Lang); May 9th, 1887, between St. Maurice and Lavey; May 18th, 1887, very abundant at Brunnen (R. J. Hutchinson); August, 1888, at Rochefort (Carlier); June 14th-16th, 1890, at Tancarville (Leech); September 2nd, 1890, at Spezia (de la Garde); August,

1891, near Boscolungo, in the Apennines (Norris); as early as April 11th, 1893, at Pont de l'Arche (Dupont); July 4th, 1893, the earliest example of the second brood noticed (Bromilow); August 22nd, 1894, at Aosta; July 25th and 26th, 1896, at Grésy-sur-Aix; April 16th-23rd, 1897, at Digne; August 10th-20th, 1897, at Susa (Tutt); April 6th-21st, 1897, at Veytaux, near Chillon (Wheeler); April and May, 1898, in the Val d'Ombla (Mrs. Nicholl); June 20th-July 9th, 1898, at Saeterstoen (Chapman); July 24th, 1898, at Grésy-sur-Aix, August 18th-20th, 1898, at Aosta (Tutt); April 6th, 1899, at Locarno (Chapman); May 12th-June 16th, 1899, generally distributed, and very common at Varallo; July 27th, 1899, at Fontainebleau (Lowe); June 1899, near Susa (Brown); March 29th, 1899, at Montreux (Wheeler); May 23rd, 1899, at Slivno, in Roumelia; June 26th, 1899, in the Rilska Valley (Mrs. Nicholl); April 6th, 1899, at Locarno; July 1st-12th, 1899, at Fusio; July 1st-20th, 1900, at Pontresina (Chapman); August 18th-24th, 1900, at Grésy-sur-Aix (Tutt); May 18th, 19th, 20th, 1901, around Granada (Mrs. Nicholl); July 30th-August 5th, 1901, at Torre Pellice (Tutt); August 9th, 1901, near Lucerne (Keynes); March 31st, 1902, at Pont du Gard (Rowland-Brown); May 26th-June 6th, 1902, between Montreux and Aigle (Barraud); June 16th-21st, 1902, at Susa, June 24th, 1902, at Pesio, mid-July, 1902, at Bozen (Lowe); June 26th-July 1st, 1902, at St. Georges (Wheeler); June 26th-30th, 1902, on the outskirts of the Fôret d'Arques, near Dieppe (Moore); April 1st-10th, 1903, at Auribeau (Tutt); April 26th-30th, 1903, at Digne (Sheldon); June 23rd and 24th, 1903, between Göschenen and Wassen (Keynes); June 11th, 1903, at Trafoi (Lowe); April 21st, 1904, at Aigle (Sloper); May 11th, 1904, at the Pont du Gard (Chapman); June 17th-23rd, 1904, at Macolin, abundant, but worn July 3rd, 1904, at Grindelwald (Lowe); July 15th, 1904, at Mendel (Rowland-Brown); July 23rd, 1904, at Basle; July 30th, 1904, at Gex; April 26th, 1905, at Carqueiranne; May 2nd-6th, 1905, at Draguignan (Tutt); April 25th, 1905, Bellerive, near Geneva (Blachier); May, very common all round Geneva, and again much less so in July and August (Muschamp); June 16th, 1905, at Martigny; July 1st, 1905, at Bérisal (Lowe); June 16th, 1905, at Montserrat; May 30th-31st, 1905, at Tibidado, near Barcelona (Standen); June 21st, 1905, near Sierre, in the Pfynwald; June 22nd, 1905, between Leuk and Leukerbad (Pearson); June 29th-July 12th, 1905, in the Wengen district (Moss); July 10th-August 5th, 1905, in the Central Pyrenees, and at Biarritz (Rowland-Brown). British records.—May 27th, 1857, at Poynings (Image); June 5th-8th, 1857, at Dorking (Trimen); May 30th, 1860, at Mansfield (Brameld); September 15th, 1866, May 18th, 1867, in Tilgate Forest (Image); May 1st, 1868, at Steyning (White); May 14th, 1868, abundant at Cirencester (Harman); June 26th, 1871, at Folkestone; June 5th, 1872, May 30th, 1873, in Monk's Wood (Raynor); May 20th, 1872, in Darenth Wood (Bower); June 1st-10th, 1874, in the Abbott's Wood district (Tugwell); May 16th, 1875, at Hurley (A. H. Clarke); May 29th, 1875, at Great Malvern (Edwards); May 9th, 1876, in Abbott's Wood (Dale); May 29th-30th, 1877, at Brockenhurst; May 22nd, 1878, at Sandown (Whittle); July 28th, 1879, the first brood still out at Castle Moreton (Fox); May 31st, 1879, May 11th, 1880, at Cuxton; May 30th, 1881, May 11th, 1882, on Box Hill

(Bower); June 10th, 1882, in the Isle of Purbeck (Bankes); May 17th, 1883, on Box Hill (Bower); June 30th-July 7th, 1883, at Witherslack (Shuttleworth); May 30th, 1884, at Witherslack (Hodgkinson); June 10th, 21st, 1884, in the Isle of Purbeck (Bankes); June 6th, 1885, at Brentwood (Burrows); June 11th, 1885, in the Isle of Purbeck; June 3rd, 1886, at Glanvilles Wootton (Bankes); June 4th, 1887, at Cuxton (Tutt); June 17th, 1887, near Ely (Archer); June 10th-21st, 1887, at Brentwood (Burrows); May 27th, 1888, on Box Hill; May 30th, 1888, at Reigate (Whittle); June 7th, 1888, at Reading (Butler); May 22nd-24th, 1889, at Brentwood (Burrows); May 22nd, 1890, at Hart (Bower); May 26th, 1890, at Shoreham, Kent (Tutt); middle of May, 1890, in Epping Forest (Bayne); May 17th, 1890, at Reading (Butler); May 26th, 1890, in the Chatham district (Tyrer); May, 1890, at Portland (Brown); May 31st, 1890, at Lockerley (Burrows); a second brood from August 2nd-September 6th, 1890, at Sidmouth (Wells); May 30th-June 6th, 1891, at Brockenhurst (James); June 1st, 1891, at Lincoln (Mackonochie); June 1st, 1891, in the Isle of Purbeck (Bankes); June 1st, 1891, at Bexley (Bower); April 30th, 1892, two specimens taken at Dorking (*teste* Smith); May 9th, 1892, at Box Hill (Bower); May 13th, June 17th, 1892, in the Isle of Purbeck (Bankes); May 26th, 1892, at Langworth (Raynor); June 3rd-12th, 1892, at Hailsham (Tugwell); June 18th-26th, 1892, at Folkestone (James); July 22nd, 1892, in the New Forest (Alderson); July 29th, 1892, at Swanage (Bloomfield); April, 1893, abundant at Riddlesdown (Fletcher); April 10th, 1893, earliest date on which seen at Gloucester (Davis); April 14th, 1893, at Instow (Hinchliff); April 14th, 1893, at Tonbridge; May 13th, 1893, at Horsley (Turner); April 17th, 1893, at Worcester Park (Kaye); April 18th, 1893, in the Wye Valley (Nesbitt); April 19th, 1893, in Abbott's Wood (Esam); April 20th, 1893, near Hereford (Blathwayt); April 21st, 1893, common on Box Hill (Bower); April 22nd, 1893, at Colchester (Harwood); April 22nd, 1893, in Pembrokeshire (Jefferys); April 29th, 1893, in Epping Forest (Frier); late in April and early in May, 1893, at Honiton (Riding); May 4th, 1893, at Langworth (Raynor); May 6th, 1893, at Cuxton; again on July 22nd, 1893, and following days at same place (Tutt); May 6th, 1893, around Pinner Woods (Rowland-Brown); May 6th, 1893, in Epping Forest (Hunt); May 10th, 12th, 31st, also on July 28th (two fresh specimens), 1893, in the Isle of Purbeck (Bankes); May 21st, 1893, at Brockenhurst (Tremayne); a second brood well out August 6th, 1893, on Box Hill (Croker); also August 6th, 1893, at Guildford (Groves); April 1st, 1894, at Folkestone (Hill); May 29th, 1894, at Legsby (Raynor); June 8th-17th, 1894, at Brockenhurst (Wells); June 14th, 1894, two at Riddlesdown (Fletcher); June 25th, 1894, in the Isle of Purbeck (Bankes); August 29th, 1894, one at Upper Norwood (Fletcher); May 5th, 1895, earliest date noted at Ashford (Wood); May 11th, 1895, one at Upper Norwood (Fletcher); May 27th, 1895, at Langworth (Raynor); May 10th, 1895, on Box Hill (Bower); May 12th, 1895, at Hurley (A. H. Clarke); May, 1895, in the Cheltenham district (Robertson); June 6th, 1895, at Newtown (Tetley); May 5th, 1896, in the Isle of Purbeck (Bankes); May 9th, 16th, 25th, 1896, at Newtown (Tetley); May 11th, 1896, in the Guildford district (Grover); May 13th, 1896, at Reading (Butler); May 23rd, 1896, at Lynwood; June 13th, 1896,

at Oxshott (Tremayne); May 23rd, 1896, in Epping Forest (Simes); a second brood July 22nd, 1896, at Sandown (Prout); May 16th, 1897, at Marlow (A. H. Clarke); May 17th, 1897, in the Guildford district (Grover); May 22nd and 23rd, June 3rd and 5th, July 4th, 1897, at Newtown (Tetley); May 22nd, 1897, at Hazeleigh (Raynor); June 11th, 1897, several on Box Hill (Bower); June 12th, 1897, at Harrow Weald (Rowland-Brown); May 17th, 1898, on Box Hill (Bower); May 9th, 1898, at Balcombe (Image); May 26th, 1898, at Hazeleigh (Raynor); June 19th, 1898, at Eastwood (Whittle); May 30th and June 23rd, 1898, at Hexham (Nicholson); June 3rd, 1898, at Leicester (Dixon); June 3rd and 11th, 1898, at Newtown (Tetley); June 6th, 1898, at Battersby (Elgee); June 11th, 1898, at Reigate (Adkin); June 21st, 1898, at Hythe (Hill); May 19th-22nd, 1899, in the New Forest (Prout); May 23rd, 1899, at Hazeleigh (Raynor); May 26th, 1899, in Epping Forest (Gardner); May 28th, 1899, at Frensham (Bingham-Newland); June 1st, 1899, at Mill Hill (James); June 3rd, 1899, on Aldbury Down (Barraud); June 4th, 1899, at Reading (Butler); June 10th, 1899, at Hilton (Sachse); June 13th, 1899, at Marlow (A. H. Clarke); May 19th, 1900, near Ayr (Dalglish); May 19th, 1900, at Hazeleigh (Raynor); May 20th, 1900, at Drayton Beauchamp, June 4th, 1900, near Tring (Rothschild); May 20th, 1900, at Reading (Butler); May 24th, 1900, at Dover (Stockwell); May 26th, 1900, in Epping Forest (Gardner); June 4th, 1900, at Hexham (Nicholson); June 4th-6th, 1900, at Newbury (Hopson); June 4th, 1900, on Aldbury Down (Barraud); June 5th, 1900, at Marlow (A. H. Clarke); June 9th-18th, 1900, in Darenth Wood and at Eynsford (Barraud); June 11th, 1900, several at Shoreham, Kent (Bower); May 16th, 1901, at Hazeleigh (Raynor); May 21st, 1901, common at Shoreham, Kent (Bower); May 24th-29th, 1901, and again August 3rd, at Burgess Hill (Dollman); May 25th, 1901, on Aldbury Down (Barraud); May 26th, 1901, at Reading (Butler); May 27th, 1901, in Sandburn Wood (Walker); June 7th-10th, 1901, at Balcombe (Image); June 9th, 1901, at West Wickham (Gardner); June 26th, 1901, two at Sandburn (Bower); August 3rd, 1901, at Ditchling (Dollman); May 24th, 1902, at Hazeleigh (Raynor); May 25th, 1902, at Reading (Butler); June 7th, 1902, at Ranmore (Step); June 11th, 1902, in Chattenden Wood (Burrows); June 26th, 1902, at Thundersley, scarce (Whittle); June 22nd-28th, 1902, at Westwell (Gardner); June 28th and 29th, 1902, at Scarborough (Tetley); May 22nd and 29th, 1903, common at Shoreham, Kent (Bower); May 23rd, 1903, in the Tring district (Barraud); May 23rd, 1903, at Sandburn (Walker); May 23rd, 1903, between Risborough and Wendover, sometimes swarms (Rowland-Brown); May 23rd, 1903, at Hazeleigh (Raynor); May 24th, 1903, at Reading (Butler); May 29th, 1903, in the New Forest; June 26th, 1903, at Westwell (Gardner); June 10th, 1903, at Taunton; June 20th, 1903, at Scarborough (Tetley); June 11th, 1903, in the Isle of Purbeck (Bankes); June 12th, 1903, latest date on which seen at Gloucester (Davis); May 20th, 1904, at Shoreham, Kent (Bower); May 20th, 1904, at Drayton Beauchamp; May 24th, 1904, near Fulbourn; May 28th, 1904, in Chippenham Fen; June 3rd, 1904, at Godstone; June 4th, 1904, near Tring; June 10th, 1904, near Oundle (Rothschild); May 21st, 1904, at Westwell (Gardner); May 23rd, 28th, 29th, 30th, 31st, June 2nd and 3rd, 1904, at Taunton; June

12th, 1904, at Scarborough (Tetley); May 25th, 1904, also a very worn specimen June 29th, 1904, at Hazeleigh (Raynor); May 29th, 1904, on Aldbury Down (Barraud); June 4th, 22nd, 27th, 1904, in the Isle of Purbeck; June 17th, 1904, at Blandford; June 24th, 1904, in the Isle of Portland (Bankes); June 6th and 8th, 1904, very scarce, at Tintern and Llandogo (Bird); May 17th, 1905, at Reading (Butler); May 19th, 1905, fairly well out at Cuxton (Tutt); May 20th-June 3rd, 1905, plentiful at Tintern and Llandogo (Bird); May 23rd, 1905, at Hazeleigh (Raynor); May 30th-June 15th, 1905, at Mucking (Burrows); June 13th, 1905, at Westwell (Gardner); June 14th, 1905, at Reigate (Image); latest date noted at Ashford, June 18th, 1905 (Wood); June 23rd, 1905, in the Isle of Purbeck (Bankes); June 23rd, 1905, worn, at Droitwich (A. H. Clarke); May 5th, 1906, at Reigate (Turner); May 13th, 1906, first specimen of the year seen at Tintern, fairly common by May 22nd (J. F. Bird); May 12th, 1906, at Hazeleigh, well out (Raynor).

Habits.—The imaginal habits of this species are extremely interesting. In the early spring, on the chalk downs at Cuxton, it darts rapidly from one bare place on the chalk to another, resting thereon for a short time with outspread wings, and rarely choosing a flower or grass blade on which to rest, although leaves of low bushes are not infrequently selected. In late July and early August, when the partial secondbrood is on the wing in southern France and north Italy, it flies rapidly along the roadways or pathways, repeatedly settling on the ground in front of one, lowering its wings, or it chooses a flowery bank, resting on a blossom with outspread wings, the convex margins of which hang over most conspicuously, whilst it swings to and fro in the breeze, its body turned towards the sun. In dull weather, however, it chooses a dead flower-head of plantain, centaurea, scabious, hieracium, etc., on which to rest, and, drawing itself below the capitulum, is not always readily noticed, although Raynor observes that, on cold days, the imago may be easily detected when at rest, especially on the dead flower-heads of knapweed, on a single head of which he has seen three specimens at rest; it also reposes on the flowers of *Plantago minor*, and the old seed-heads of *Juncus communis*, and various grasses. He says that, on May 30th, 1905, he observed fourteen specimens, which had just settled down for the night, upon dead flower-heads of knapweed, all in exactly the same position, *i.e.*, with their backs to the sun, which was shining brightly, heads uppermost, wings folded down, wrapped over the dead, chequered, brown, weather-worn flower-heads which form a very remarkable similarity to the butterflies, touching which, only made them settle down all the closer: none could be found in the immediate neighbourhood settled on any other plant. As long ago as 1857, Trimen recorded the peculiar mode that the species had of resting when asleep. He notes (*Intell.*, ii., p. 101) that, at Dorking, June 5th, 1857, whilst collecting *Cupido minima* in a chalk-pit, just at sunset, he saw what appeared to be a small Noctuid, resting on a thick stalk of grass, and, on stooping to examine it, found it to be a specimen of *Nisoniades tages*, apparently fast asleep, as tapping the grass on which it rested, several times, did not cause it to move; the wings were folded so as to form a roof, as in most of the Lachneids and Noctuids, with the upper-

side outwards. He thought, at first, this might be an exceptional instance, but on the 8th, in the same chalk-pit, during a slight shower of rain, he found another in a precisely similar position, and so was induced to believe that it must be a regular practice. The observation was confirmed by Speyer (*Lep. Faun. d. Fürst. Waldeck*, 1867, p. 172), who, several times, noted that the butterfly, when really at rest, sleeping, carried its wings folded, roof-like, after the manner of most Noctuids. It was later recorded by Frohawk, who, on June 12th, 1883, found a grasshead, on which there seemed to be a Noctuid at rest. The insect proved to be a specimen of *N. tages*, the wings held in exactly the same position as a Noctuid when resting; the anterior wings entirely covered the posterior wings, the head lowered so as to touch the grass, and antennæ bent back parallel with the costal margin of the wings. The colours of both butterfly and grass-head upon which it rested, were of wonderful similarity, and, coupled with the position taken up on the brown tuft, were a remarkable and perfect disguise. An excellent drawing accompanies Frohawk's note (*Ent.*, xvii., p. 49). Bankes writes (*in litt.*) that, "on the evening of June 23rd, 1905, he noticed, in the Isle of Purbeck, a specimen roosting for the night on the stout brown upright seedhead of a coarse grass (*Dactylis glomerata*, unless memory is at fault), to which it was clinging, head upwards, with the forewings, which formed a triangle, nearly concealing the hindwings, and sloping away gently outwards from the line of their approximating dorsal margins, like a rather flat-pitched roof from its ridge. The protective resemblance of the butterfly to the grass seedhead was most remarkable." He observes that "a somewhat similar sleeping-position of *N. tages* was described and figured in *Entom.*, xvii., p. 49 (1884), but, in that case, the grass-head was almost horizontal, with the butterfly resting along the underside of it, the anterior wings entirely covered the posterior, and the outward slope of the former appears to have been more pronounced." He further adds: "I have noticed that *N. tages*, when kept in the dark in confinement, does not repose with the wings closed over the back like most of our 'skippers,' but holds them nearly horizontally, in almost the same position as when it is basking in the sunshine." Very few observers have recorded the butterfly as resting on blossoms, when actively on the wing in the sun, we only note it flying at flowers of selfheal at Hexham (Nicholson), at flowers of *Thymus serpyllum*, at Salzburg (Richter), at flowers of *Nepeta glechoma*, *Lotus corniculatus*, *Lysimachia nemorum* (J. F. Bird), etc. Schmidt reports that it rests and suns itself commonly on the low plants and bushes, and flies blithely round the borders of the Rugensee Woods, in Mecklenburg; whilst Glaser observes that, in Oberhessen, it loves to run in the sunshine over the ground, or over stones, in fields, and woodland roads, like a fly; he also notes it as being fond of sitting in damp places. Mann also records its predilection for damp places in roads in Carniola. Gillmer observes that it rests on blossoms of thyme and on the bare ground, spreading out its wings in the sunshine, and remaining for a considerable time in one place if not disturbed; the flight is rapid, but not often sustained for any length of time, the butterfly soon resting again. Bird says that "this species flits about rather close to the ground, seldom flying more than a foot or two above the herbage, except when one is chasing another (possibly a ♂ pursuing a ♀); at this time, the two will circle around each other and mount upwards to a height of some 8ft.

Their usual flight is brisk and zigzaggy, but somewhat short; they are more difficult to follow with the eye than *Hesperia malvae*, especially when passing over clumps of dead bracken. Flowers do not appear to be a very great attraction, although they will sip from the blossoms of *Veronica chamaedrys*, *Viola canina* and daisies, whilst the first example seen this year (1906), flew repeatedly to the blossom of *Nepeta glechoma*, although this had wandered into an orchard from its ordinary habitat. Usually, when the imagines settle it is to rest, or to bask in the sun's rays; they then love to sit close to the ground, on dry bracken fronds, or other dead vegetation, and often on patches of bare earth; although they occasionally rest on grass and low-growing plants, where the herbage is growing sparingly. They have a curious trick of hovering about objects, such as an old thistle-stem, or the end of a dead bramble-shoot, frequently looking as if about to alight, but usually flying off and choosing a less prominent object on which to settle, only rarely poising themselves on anything so conspicuous. Like *Hesperia malvae* they rest tail to the sun, and generally spread out their wings flatly or even slightly deflected, especially when a cloud passes over the sun, but, in hot sunshine, they occasionally raise their wings slightly, and slowly move them, keeping the upper wings apart from the lower, more often they raise their wings well up, sometimes so far that they almost meet. The manner in which they disappear during a long cloudy period is rather remarkable, nor can they be at all easily disturbed, neither are they immediately in evidence when the sun reappears, preferring, no doubt, to enjoy the warmth before starting to fly again. They appear not to pass gloomy days and bad weather in the same position as when they sleep; at least, we cannot discover them. *Nisoniades tages* does not seem to be a very pugnacious insect; it will certainly fly up at any small butterfly that is passing, but it soon settles again, and the habit appears principally due to a desire to investigate the character and sex of the intruder." It prefers to rest on the ground in the more arid areas of the forest district of Pont de l'Arche (Dupont). Raynor notes that during copulation the ♀ hangs downwards.

Habitat.—In Britain, the species is rarely found in woods, unless they are very open, or on chalky or limestone hillsides. The open chalk downs of Kent and Surrey, the flowery openings by the edges of the woods capping the chalkhills, and meadows near, are its favourite haunts in the southeastern counties, but it also occurs in the open ridings of Chattenden and other woods, far removed from the chalk. In Monmouthshire, one of its favourite haunts is a rough hillside pasturage, with masses of bracken (represented at this time chiefly by last year's withered fronds) growing therein. Woods almost surround this place, and near by are thickets, and clumps of alder, birch, hazel, bramble, etc. (J. F. Bird). At Cuxton, in Kent, it prefers the dry, chalky slopes on the outskirts of the woods, choosing the rough grassy parts, where bare patches are frequent, and sheltered corners are formed by the shaws that run up from the fields below to join the woods that cap the hills. It is common on the railway-banks and in the meadows at Market Drayton (Woodforde); on the sandhills at Llandudno (Harding); also in the marl-quarries at the same place (Court); on the heaths at Witherslack (Forsythe); on wayside ground and on the banks bordering a large fir-wood at Hexham (Nicholson); on the hillsides at Dovedale (Brown); on railway-banks and in cuttings, on hillsides and in woods, in Herefordshire (Bowell); on railway-banks near

Lynwood (Tremayne); on a railway embankment a few miles south of Ayr (Dalglish); in the meadows around Pinner Woods (Rowland-Brown); on the uncultivated chalk-downs at Drayton Beauchamp, in the grassy ridings at Oundle, and in a marshy spot at Godstone. (Rothschild); the woods and dry banks around Lewes (Jenner); and the glades of Epping Forest (Bayne). It is found on the stony limestone pastures of Clare (Kane); the islands of Loch Erne (Allen); on the dry oolitic hillsides of the Cotteswolds, in Gloucestershire (Watkins); and on the roadside between Portland and Weymouth (Mathew). Although common in Epping, only a single specimen had occurred in the Colchester district previous to 1893, but, in that year, several were found in the High Woods, and since then it has been quite common there (Harwood). It is not uncommon on heaths and old pastures, from 600ft. to 800ft. above sea-level, in northwest Durham (Dewar); it also occurs in dry lanes and on heaths in both Northumberland and Durham (Wailes). On the continent, it is exceedingly widely distributed in a great variety of habitats, Miss Fountaine asserting that it appears to occur everywhere in Europe and Asia Minor. Our own experience with it suggests very varied habitats. The grassy uplands on the mountains around Digne, the cistus-clad slopes at the Pont du Gard and Carqueiranne, the meadows by the Siagne at Auribeau, the grassy banks and gardens around Draguignan, the box-covered hill-slopes above Grésy-sur-Aix, the flowery meadows among the vineyards at Susa, the thyme-clad wilds near Torre Pellice, and the meadows around Basle, may be noticed as being among the haunts of the species. It also occurs on the mountain slopes at Grasse (Tutt), at Granada (Nicholl), at Pontresina, Fusio, and around Brunnen (Chapman), at Macolin (Lowe), and at Mendel (Rowland-Brown). It is not a common species at more than 5000ft. in the Alps of Central Europe, although it has been recorded from the Stelvio (Wocke). It goes up the Tyrolean Alps to 6000ft. (Weiler), and, on the Prenj Mountains, in the Hercegovina, it is not uncommon up to 5700ft. (Penther). It abounds on the hillsides in the neighbourhood of the Fôret d'Arques, near Dieppe (Moore); on the coast of Brittany, from Cancale to St. Malo (Oberthür), whilst in the Pont de l'Arche district, it prefers the dry parts of the forests (Dupont); and Bruand notes it as haunting the fields and roadsides in the dept. Doubs. It occurs on the warm slopes of the foothills near the coast at Spezia (de la Garde), and of Corfu (Norris). In Hungary it is common on the banks of the river at Herculesbad (Lang), and, in Bohemia, although generally common, prefers dry, sunny places (Hüttner); in the Salzburg district, it extends from the plains up to the alps, being most abundant on the mountain slopes where *Thymus serpyllum* grows, and is particularly plentiful on the slopes of the Gaisberg (Richter), whilst, in the Tyrol, it also goes high into the mountains, and, about Innsbruck, reaches from the valleys to the sub-alpine region, at an elevation of 6000 ft. (Weiler). In Germany, its habitats appear to be much the same as in Britain, *e.g.*, in Pomerania, it chooses meadows near woods (Paul and Plötz), as also it does in the Rhine Provinces (Weymer). In Mecklenburg, it prefers openings in woods, their borders, and the broad open paths running through them, but appears to occur, like *Cyclopides sylvius*, only in the woods and forests that are situated on heavy soils (Schmidt). In the Oberharz, it chooses dry,

grassy places, but is more common among the foothills of the Harz Mountains (Gillmer); in Hesse-Nassau, it is generally distributed in fields, woods, woodland roads, bare, stony hillocks, and is sometimes particularly abundant in stone quarries (Glaser); in Waldeck, it haunts dry sunny openings on the borders of woods, woodland-meadows and roadsides (Speyer), whilst, near Zeitz-on-Elster, it is also found in woodland-meadows and open places in woods, but, on the Mosigkauer Haide, in the duchy of Anhalt, it is distributed over the heaths, in dry, sunny, grassy places, and haunts the bare spots found there (Amelung). In Silesia, it is everywhere common in open woods and woodland-meadows, but goes up into the mountains to about 2000 ft. elevation (Wocke), whilst it is distributed over the whole of the "heath" or "Haide" district in the neighbourhood of Sprottau (Pfitzner). In the kingdom of Saxony, it is found on dry, sunny slopes, or in open places in woods (Steinert), and, in Bavaria, the borders of woods and dry sterile places are its chief haunts (Schmid), whilst, in Anhalt, it prefers openings in woods, roadsides passing through woods, and at Ilmenau, in Thuringia, it is common in meadows in the drives of the Schorte (Gillmer).

Localities. — Generally distributed throughout the British Islands, although local, being particularly so in Ireland and Scotland. Ayr: near Ayr (Dalglish). [Banff (Brown).] Bedford: Barton Hills (Nash), Bedford, Luton (Vict. Count. Hist.). Berks: Bagley Wood, Boar's Hill (Geldart), Newbury (Beales), Reading (Butler), Hurley (A. H. Clarke). Bucks: Chiltern Hills, Kimble district (Rowland-Brown), Halton, Wavendon, near Newport Pagnel (Stainton), Drayton-Beauchamp (Rothschild), Marlow (A. H. Clarke), Stoney-Stratford (Foddy), Buckingham (Slade). Cambridge: Chippenham Fen, Fleam Ditch, near Fulbourn (Rothschild), near Ely (Archer), Boxworth (Thornhill), Cambridge (Crisp). Carnarvon: on limestone in Llandudno district (Newstead), Conway Valley, very common (Bland), North Cardigan Bay, mouth of Conway (Gardner), Capel Curig (Birch). Cheshire: rare and local—Wirral, between Spital and Bromborough (Ellis), Gill Brook, near Flaybrick (Prince), Ledsham (Sharp), near Bromborough (Gardner), Shavington Park (Thornewill), Cottrell Wood (Edelsten), Birkenhead (Stainton). Clare: abundant throughout the Burren—from Dromoland, Kilfenora to Ballyvaughan, Ennis (Kane), Cratloe (Nugent). Cornwall: Truro (Rollason). Cumberland: Keswick district, uncommon and local (Beadle), Carlisle, Wreay, Gelt Wood, Newby, Silloth (F. H. Day), Lake district—Isel, Udale and Aspatria Road, abundant (Whittaker), Castle Carrock (Routledge), Orton, Kingmoor, Todhills, Newbiggin (Dawson). Denbigh: Colwyn Bay (Whittaker), Llandulas (Pitcairn-Campbell), Abergele, Pensarn, Minera and Llangollen districts (Newstead), Llanferres, Cefn Caves, near Ruthin (Gardner), Ruthin (Butler). Derby: common in the dales (Fuller), Dovedale (Brown), Lathkil Dale (Sheldon), Longstone Edge (Hill), Bakewell (Payne). Devon: common (Mathew), Exeter, Plymouth, Teignmouth (Stainton), Sidmouth (Majendie), Instow (Hinchliff), Honiton (Riding), Dartmoor (Gummer), Torquay and neighbourhood (Crocker), Lynmouth (T. H. Briggs), Silverton (Ward), Torrington (Doidge), Paignton district (Goodale). Dorset: south Dorset, generally abundant (Bogue), Portland (Brown), Swanage (Bloomfield), Lulworth (Dale), Blandford (Stainton), Charmouth, Lyme Regis (Morris), Sherborne (Kimber), Wimborne, Hod Hill (Fowler), Weymouth (Mathew), Isle of Purbeck, Blandford, Glanvilles Wootton, Isle of Portland (Bankes). Durham: common (Wailes), Shull (Backhouse), Chopwell (Hedworth), Hartlepool, Black Hall Rocks (Robson), Darlington (Stainton), Sunderland (Corder), Hart (Bower), Stanley (Dewar). [Elgin (Brown).] Essex: Epping Forest (Bayne), Colchester (Harwood), Thundersley, Eastwood (Whittle), Hazeleigh, Shenfield, Woodham Ferris (Raynor), Raydon Wood (Morris), Harwich (Mathew), Brentwood, Mucking (Burrows), Ongar Park Woods (Wright). Fermanagh: Enniskillen, locally abundant (Sinclair), Lough Erne (Allen). Flint: the coast of the county (Gardner), Bagillt (Walker). Galway: near Galway (Birchall), Ardrahan (Nugent), Castle Taylor (Kane).

Glamorgan: Swansea district, Milford Haven (Robertson), near Cardiff (Shelley). Gloucester: generally distributed—Bristol district, common (Hudd), Lower Guiting (*teste* Stainton), Cotswold Hills (Jefferys), Cheltenham (Robertson), Cirencester (Harman), Castle Moreton (Dobrée-Fox). Hants: Brockenhurst (James), Isle of Wight—Bembridge (*teste* Stainton), Sandown (Prout), New Forest—Lynwood (Tremayne), Lyndhurst, Winchester (Hewett), Portsdown Hill, Shedfield (Pearce), Ringwood (Fowler), Lockerley (Burrows). Hereford: Tarrington (Wood), Leominster (Hutchinson), Hereford (Bowell), Woofferton (Lucas). Herts: Tring, Aldbury Down (Barraud), Hertford Heath, Hertford (Stephens), Oxhey (Rowland-Brown), Norton Green Woods (Matthews), Broxbourne Woods (Boyd), Dancer's End (Rothschild), Bricket Wood, Moneybury Hill (Gibbs), Hitchin, Sandridge (Griffith), East Barnet (Gillum), Watford (Spencer). Hunts: fen district (Oldham), Monks Wood (Raynor), St. Ives (Norris). Inverness (White). Kent: Ashford, common (Wood), Wye Downs (Raynor), Shoreham, Cuxton (Tutt), Chatham (Tyrer), Bexley (Fenn), Hythe (Hill), Maidstone district (Golding), Darenth, Dover (Stephens), Eynsford (Barraud), Pembury, Tenterden (Stainton), Deal (Carr), Appledore, Folkestone Warren (Heitland), Tonbridge (Turner), Herne Bay (Battley), Chattenden (Burrows), Sevenoaks (Holmes), Westwell, West Wickham (Gardner). Longfield, near Gravesend (Jennings), Frant, Tunbridge, Pembury (Cox). Kerry: Killarney—Muckross, Enniscorthy (Moffat). Kirkcudbright (White). Lancs: Arnside (Forsythe), Grange, abundant (Hodgkinson), Silverdale (Melvill), Chat Moss (Chappell), Manchester, Preston (Stainton), Holker Moss (Crabtree), Carnforth, Wharton, Ulverston (Murray). Leicester: Leicester (Dixon), near Loughborough (Wieldt), Gumley (Matthews). Lincoln: Lincoln (Mackonochie), Newball, Skellingthorpe (Carr), Legsby Wood, near Market Rasen, Langworth, Hatton (Raynor). Merioneth: Artro valley, near Barmouth (Arkle), Festiniog (Bairstow). Middlesex: Kingsbury, Stanmore (Bond), Harrow district (Rhoades-Smith), Ruislip (Watts), Mill Hill (James), Willesden, Harrow Weald, Stanmore Common, Pinner Woods (Rowland-Brown), Enfield (Sykes), Finchley (Southey), Southgate (Battley). Monmouth: Wye valley (Nesbitt), Monmouth (Palmer), Tintern, Llandogo (Bird). Montgomery: Newtown (Tetley). Northampton: Peterborough (Stainton), Ashton Wold, Oundle (Rothschild), Northampton (Tomalin). Northumberland: Hexham (Nicholson), Dalton (Rosie), Twizell (Wailes). Notts: Mansfield (Brameld). Oxford: Oxford (Stainton), Chinnor (Spiller). Pembroke: Pembroke (Jefferys), Castlemartin (Puckridge). Radnor: Wye Valley—Erwood (Vaughan). Ross (White). Staffs: Leycett, Coal Pit Lows (Freer), Market Drayton (Woodforde). Shropshire: Shavington Park, on borders of county (Thornewill), Shrewsbury (Stainton). Somerset: generally distributed, and common (Hudd), Shepton Mallet, common (Bogue), Porlock (Carr), Castle Cary (Macmillan), Taunton (Doidge). Suffolk: locally common (Bloomfield), Stowmarket (Stainton), Sudbury district (Gerrard). Surrey: Dormans Park, Warlingham (Burr), Dorking (Oldaker), Horsley (Turner), Box Hill (Croker), Oxshott (Tremayne), Oxted, Purley (Sheldon), Riddlesdown, Upper Norwood (Fletcher), Frensham (Bingham-Newland), Coombe Wood (Stephens), Worcester Park (Kaye), Woking (Russell), Guildford (Grover), Godstone (Rothschild), Croydon (Hall), Reigate (Whittle), Ranmore (Step). Sussex: Lingfield, East Grinstead (Thomas), Poynings, Tilgate, Balcombe (Image), Abbott's Wood (Esam), Burgess Hill, Ditchling (Dollman), Brighton, Lewes, Worthing (Stainton), Hastings district, somewhat rare (Bloomfield), common in east Sussex (Jenner), Cissbury (Fletcher), Hailsham (Tugwell), Shipley (Bird), Polegate (Hamlin), Steyning (White). Warwick: Sutton Park (Lee), Coventry (Kenrick), Hampton-in-Arden (Wynn), Knowle, Umberslade (Kess), Corley Woods (Bree), Rugby, Brandon, Princethorpe (Rugby lists), Atherstone (Baker), Ettington (Keighley-Peach), Wolford (Wheeler), Coombe Wood (Longstaff). Westmorland: Kendal district, Windermere, common (Moss), Lake district (Stainton), Ambleside (Buckton), Witherslack, plentiful (Hodgkinson). Wigtown: near Stranraer, near Loch Elrig, Monreith (Gordon). Wiltshire: Salisbury (Carr), Corsham (Stainton). Worcester: common (Fletcher), Bromsgrove (Stainton), Great Malvern (Edwards), Droitwich (A. H. Clarke). Yorks: Sandburn Wood, Strensall (Walker), Cleveland district—Hilton (Sachse), Hull district—Humber bank, Hessle, formerly (Boult), Levisham (Porritt), Askham Bog (Prest), Barnsley (Harrison), Bishop's Wood, Raskelf (Tyers), Bramham (Smith), Huddersfield (Varley), Pannal (Taylor), Pontefract (Hartley), Richmond (Sang), Roche Abbey (W. H. Smith), Scarborough (Rowntree), Sheffield (Doncaster), Wakefield (Talbot), York (Stainton), Battersby (Elgee).

Distribution.—Europe (except polar region); western Asia, Altai, with Dahuria, Amurland, northern China, Asia Minor, eastern Nan Shan (Staudinger and Rebel). Asia: Asia Minor, widely distributed (Fountaine), Syria—Akbès, Smyrna (Staudinger), Amasia (Caradja), Transcaucasia—Borjöm (Alphéraky), western China—Siao-Loû (Oberthür), Altai, North China—Pekin district (Speyer), the Sinian Alps (Grum-Grshimailo), Tibet—Koko-Nor, Amurland (Elwes), the banks of the Schilka and Amur (Radde). Austro-Hungary: everywhere more or less common, Bohemia, everywhere—Karlsbad (Hüttner), Prague, Senftenberg (Fritsch), Moravia—Brünn, etc. (Schneider), Neutitschein (Fritsch), Upper Austria, throughout—Wels, etc. (Brittinger), Freistadt, Lenz, etc. (Fritsch), Lower Austria, common—Vienna district (Schleicher), Hernstein district up to 1400m. (Rogenhofer), Gresten (Fritsch), Salzburg — throughout, lowlands and mountains, very common on the Gersberg, Gaisberg, etc. (Richter), Tyrol—Glockner district, Bozen, the Dolomite district (Mann), Mendel Pass (Rowland-Brown), Innsbruck, Taufers Valley (Weiler), Schlücken-Alpe, Ratzes, Seiseralpe, Schluderbach, Stilfser Joch, Laugen (Heller), Carinthia, throughout—the Prediel, etc. (Zeller), Carniola (Mann), Dalmatia—Spalato, etc. (Meyer-Dür), Transsylvania (*teste* Speyer), Galicia (Garbowski), Buda-Pest district, everywhere, Lipnik (Aigner), Herkulesbad, etc. (Lang). Belgium: throughout—very abundant around Namur, etc—the whole left bank of the Meuse (Lambillion), and the right bank of the Meuse (Sibille), Elderen, Haute Marlagne (Derenne), Tirlemont (Halflant), Jambes (Naniot), Vallée de la Molignée (Lambillion), Virton (Cabeau). Bosnia and Hercegovina: distributed up to 1900m.—Dervent (Hilf), Fojnica (Simonys), Sarajevo, Trebevic (Saraj. Mus.), the Romanja-Planina, Igmàn (Apfelbeck), Maklenpass, Radusa-Planina, Jablanica (Hilf-Leonhard), the Prenj, Krstac, Plasa (Penther). Bulgaria and East Roumelia: near Sofia, in the Rilo mountains (Elwes), Rilska valley, Slivno (Nicholl), Rasgrad, Rustchuk (Rebel). Corsica (Mann). Denmark: Skove (Bang-Haas). France: throughout—Nord (Paux), Seine-Inférieure—Forêt d'Arques near Dieppe (Moore), Tancarville (Leech), Calvados (Moutiers), Brétagne (Griffith), Eure—Pont de l'Arche, Deux Amants (Dupont), Ille-et-Vilaine — Rennes, Côtes-du-Nord — coast from Cancale to St. Malo (Oberthür), Manche — Trouquets, near Cherbourg (Nichollet), Eure-et-Loir — Châteaudun (Guenée), Auvergne district—Nohant, St. Florent, Sologne, Guéret (Sand), Aube (Jourdheuille), Indre (Martin), Allier—Moulins (Peyerimhoff), Saône-et-Loire—Autun (Constant), Aude (Mabille), Haute-Garonne (Caradja), Gironde (Brown), Biarritz (Elwes), throughout the French Pyrenees (Rondou), (Pyrénées-Orientales—Vernet-les-Bains, Hautes-Pyrénées—Cauterets (Oberthür), Dordogne (Tarel), Haute-Marne (Frionnet), Loire-Inférieure (D-Roy), Doubs—Besançon (Bruand), Gard—Pont du Gard, Avignon (Rowland-Brown), Basses-Alpes—Digne (Tutt), French Juras—St. Georges (Wheeler), Gex, etc., Savoy-Alps—Aix-les-Bains, Grésy-sur-Aix (Tutt), Alpes-Maritimes (Millière), Escarène, Furacare (Oberthür), Nice, etc—very common (Bromilow), Cannes, Auribeau, Grasse, Var—Hyères, Carqueiranne, Draguignan (Tutt), Ste. Maxime (Chapman), Aisne—Bois d'Holnon (Dubus). Germany: Prussia, common—Rastenburg, Dantzig (Schmidt), Dammhof, Gross-Raum, Metgethen, Königsberg, Löwenhagen, Tapiau, Wehlau, Wöterkeim, Bartenstein, Mohrungen, Osterode, Allenstein, Diwitten, Gr. Bertung, Graudenz, Elbing, Zoppot, Karthaus, Jastrow (Speiser), Pomerania—Forsthaus Kokendorf, Pulvermühle, Misdroy (Hering), Pennin (Paul and Plötz), Mecklenburg-Schwerin and Mecklenburg-Strelitz—Wismar (Boll), Gadebusch, Kleinen, Wendisch-Rambow, Rugensee, the woods of the Geestland of Mecklenburg (Schmidt), Lübeck, on the Wesloer Moor, Lauerholz, and Wesloer Tannen (Tessmann), Schwerin, Parchim (Gillmer), Lauenburg, Hamburg and Schleswig-Holstein—Eutin (Dahl), Hamburg (Beske), Altona (Tessien), Bremen and Hanover — Bremen (Rehberg), Lüneburg (Steinvorth and Machleidt), Hanover (Glitz), Osnabrück, Hameln, Osterode, Göttingen (Jordan), Brunswick and Harz — Brunswick, Wolfenbüttel (Heinemann), Helmstedt, Quedlinburg (Jordan), Oberharz (Hoffmann), foot-hills of the Harz (Gillmer). Westphalia—Münster (Speyer), Höxter (Jordan), Rhine Provinces — Uerdingen, from Trier to Wesel (Stollwerck), Barmen, Elberfeld (Weymer), Crefeld (Rothke), Neuenahr (Maassen), Hesse-Nassau, Oberhessen and Waldeck — Nassau, Wiesbaden (Rössler), Oberursel (Fuchs), Hanau, Steinheimerwald, Wilhelmsbad (Limpert and Röttelberg), Amtsbezirk Wied-Selters (Schenck), near Giessen (Glaser), Frankfort-on-Main (Koch), Cassel (Borgmann), Waldeck (Speyer), Rotenburg-on-Fulda (Jordan), Thuringia to 2000ft.—Erfurt (Keferstein and Werneburg), Schwansee, in Steigerwalde and Willrodaerforste (Ent. Verein

Erfurt), Rudolstadt (Jordan), Province of Saxony—Zeitz-on-Elster, Raassberg, Ossig (Wilde), Dessauer (Mosigkauer) Haide, Schkeuditz (Stange), Rosslau (Richter), Mühlhausen, Naumburg, Sondershausen, Nordhausen, on the Kyffhäuser (Jordan), Brandenburg — Frankfurt-on-Oder (Kretschmer), Posen—Moschiner-Aahöhen, Owinsk (Schultz), Silesia—Brieg (Döring), the Seefelder near Reinerz (Standfuss), Trebnitzer-Gebirge (Nohr), Upper Lusatia (Möschler), Sprottau district, Wichelsdorf, Ebersdorf, Mückendorf, Küpper, Bullendorf (Pfitzner), Glogau (Speyer), Kingdom of Saxony—Dresden district (Steinert), Saxon Upper Lusatia (Schütze), Freiberg-in-S. (Fritzsche), Chemnitz (Pabst), Leipzig (Heyne), Bavaria—Regensburg (Hofmann and Herrich-Schäffer), Munich (Kranz), near Augsburg (Freyer), Kempten (von Kolb), Erlangen (Speyer), Württemberg, everywhere (Keller and Hoffmann), Baden, everywhere—Carlsruhe, etc. (Gauckler), Pfalz and Hesse-Darmstadt (Bertram), Alsace—Forêt de Lutterbach (Gerber), Doller (Michel), Basle, banks of the Weise (Peyerimhoff). GREECE: islands of Grecian Archipelago—Corfu, Tino (Erber *teste* Staudinger), Kalávryta (Fountaine), the Parnassus, Veluchi (Krüper *teste* Staudinger). ITALY: Tuscany, throughout —Roman Campagna, etc., (Stefanelli), Lombardy—Monti di Vill'Albese (Turati), Foligno (Zeller), Pistoiese Apennines (Verity), Apennines, near Boscolungo (Norris), Piedmont — Chivasso (Fountaine), Torre Pellice, Susa, Val d'Aosta (Tutt), Pesio, Varallo (Lowe), Naples district, Calabria (*teste* Speyer), Sicily, one (Ghiliani. Palumbo says that it wants confirmation), Osimo (Spada), Spezia (de la Garde). NETHERLANDS: Gelderland — Empen, Zutphen, Vorden, Arnhem, Limburg (Snellen). ROUMANIA: distributed (Fleck), Grumazesti (Caradja). RUSSIA: Baltic Provinces—Oesel, Pichtendahl (Nolcken), Caucasus district (Bramson), Volga district—Saratov, Sarepta, foothills of the Ural by the Sakmara (Eversmann), Neurussland, throughout (Nordmann). SCANDINAVIA: Norway—not above 60° N. lat. (Siebke), Saeterstoen (Chapman), Christiansand (Morton), Christiania district, Odalen, Naes Vaerk, Laurvik, Bergen, Kalfaret, Flöifjeldet (Siebke), Vallo, Hvalöerne, Sireosen (Strand), Hunneberg (Caradja), Sweden—Skania to Helsingland (Lampa). SPAIN: Granada (Nicholl), the Albaraccin district—Hermitage of Molino in S. Eulalia, Griegos, Valdeminguete, near Tajo, Camarena (Zapater and Korb), Barcelona district—San Gervasio, San Genis (Martorell), Valladolid (Oberthür), Montserrat, Tibidado, near Barcelona (Standen), Bilbao (Standfuss). SWITZERLAND: throughout—Basle (Tutt), Geneva district, common (Muschamp), the Valais, general from 2000 ft.-4000 ft., also at Saas-im-Grund, Arolla, etc. (Jones), Aigle, St. Maurice, Lavey (Hutchinson), Montreux, foot of Rochers de Naye (Barraud), Veytaux (Wheeler), Lauterbrunnen district — Wengen, Villars (Moss), Sierre (Pearson), Riedt, near Wallisellen (Dietrich), Lucerne (Keynes), Kandersteg (Harcourt-Bath), Brunnen, Engadine, throughout, Fusio, etc. (Chapman), Pontresina (Nicholson), Andermatt (Jones), Lake district—Locarno, etc. (Chapman), Lucerne (Lang), Leuk and Leukerbad (Pearson), Sépey, Rossinière, Val d'Hérens, Visp Valley (Tasker). TURKEY: Port Baklar (Walker), Crete (Weissenborn *teste* Staudinger).

## Catalogue of Palæarctic Urbicolides.

URBICOLIDES.
HESPERIIDÆ.
PHOCIDINÆ.
PHOCIDIDI.
Orthophœtus, Wats.
omeia, Leech
Capila, Moore
translucida, Leech
Achalarus, Scud.
bifasciatus, Brem.
*var.* contractus, Leech
simplex, Leech
proximus, Leech
Celænorrhinus, Hb.
maculosa, Feld.
consanguinea, Leech
tibetana, Mab.
Daimio, Murr.
tethys, Mén.
*var.* chinensis, Staud.
sinica, Feld.
diversa, Leech
Satarupa, Moore
nymphalis, Spr.
HESPERIINÆ.
NISONIADIDI.
Hallia, Tutt
marloyi, Bdv.
pelias, Leech
*var.* erebus, Grum-Grsh.
Nisoniades, Hb.
tages, Linn.
*ab.* isabellæ, Lamb.
*ab.* alcoides, Tutt
*ab.* transversa, Tutt
*ab.* variegata, Tutt
*ab.* brunnea-unicolor, Tutt
*ab.* brunnea-alcoides, Tutt
*ab.* brunnea-transversa, Tutt
*ab.* brunnea-variegata, Tutt
*ab.* unicolor, Frr.

*ab.* approximata, Lowe
*ab.* suffusa-alcoides, Tutt
*ab.* suffusa-transversa, Tutt
*ab.* suffusa-variegata, Tutt
*ab.* fulva, Bankes
*var.* cervantes, Grasl.
*ab.* clarus, Carad.
*var.* popoviana, Nordm.
*var.* sinina, Grum-Grsh.
montanus, Brem.
*var.* nigrescens, Leech
leechii, Elw. and Edw.
ERYNNIDI.
Erynnis, Schrk.
alceae, Esp.
*var.* australis, Zell.
althææ, Hb.
*var.* bæticus, Rbr.
lavatheræ, Esp.
HESPERIIDI.
Sloperia, Tutt
poggei, Led.
*var.* lutulentus, Grum-Grsh.
Muschampia, Tutt
proto, Esp.
*var.* mohammed, Obth.
leuzeæ, Obth.
staudingeri, Spr.
*var.* plurimacula, Chr.
*var.* proteus, Staud.
*var.* prometheus, Grum-Grsh.
Favria, Tutt
tessellum, Hb.
*var.* nomas, Led.
*var.* dilutior, Rühl
*var.* gigas, Brem.
*var.* kuenlunus, Grum-Grsh.
cribrellum, Evers.
*var.* obscurior, Staud.
nobilis, Staud.
Hesperia, Fab.
antonia. Spr.
*var.* gigantea, Staud.
sidæ, Esp.
carthami, Hb.
*var.* moeschleri, H.-Sch.
*var.* valesiaca, Rühl
cinaræ, Rbr.
andromedæ, Wallgrn.
centaureæ, Rbr.
serratulæ, Rbr.
*ab.* tarasoides, Rbr.
*var.* cæcus, Frr.
*var.* major, Staud.
*var.* alveoides, Staud.
cacaliæ, Rbr.
speyeri, Staud.
alveus, Hb.
*ab.* funginus, Schilde
*var.* conyzæ, Gn.
*var.* carlinæ, Rbr.
*var.* onopordi, Rbr.
*var.* cirsii, Rbr.
*var.* iberica, Grum-Grsh.
*var.* sifanicus, Grum-Grsh.
alpina, Ersch.
*var.* darwazica, Grum-Grsh.
malvæ, Linn.
*ab.* albina, Tutt
*ab.* taras, Bergs.
*ab.* intermedia, Schilde
*ab.* zagrabiensis, Grund
*ab.* fasciata, Tutt
*ab.* restricta, Tutt
*ab.* brunnea, Tutt
*var.* (et *ab.*) australis, Tutt
*var.* melotis, Dup
*var.* hypoleucos, Led.
*var.* pyrenaica, Tutt
*var.* andalusica, Tutt
*var.* alpina, Tutt
*ab.* rufa, Tutt
? *var.* malvoides, Elw. and Edw.
Bremeria, Tutt
bieti, Obth.
maculatus, Brem.
*var.* amurensis, Staud.
*var.* thibetanus, Obth.
*var.* zona, Mab.
*var.* albistriga, Mab.
*var.* sinicus, Butl.
oberthueri, Leech
Powellia, Tutt
geron, Wats.
phlomidis, Hch.-Sch.
*var.* jason, Kind.
orbifer, Hb.
*ab.* eucrate, Frr.
*var.* tesselloides, Hch.-Sch.
*ab.* hilaris, Staud.
*var.* lugens, Staud.
sao, Hb.
*ab.* eucrate, Ochs.
*var.* therapne, Rbr.
*var.* ali, Obth.
URBICOLIDÆ.
AEROMACHINÆ.
AEROMACHIDI.
Taractrocera, Butl.
flavoides, Leech
Ampittia, Moore
trimacula, Leech
delailama, Mab.
Aeromachus, Nicév.
chinensis, Elw. and Edw.
piceus, Leech
inachus, Mén.
catocyanea, Mab.
CYCLOPIDINÆ.
CYCLOPIDIDI.
AUBERTIA, Obth.
micio, Obth.
dieckmanni, Graes.
*var.* gemmatus, Leech
christophi, Grum-Grsh.

niveomaculatus, Obth.
flavomaculatus, Obth.
argyrostigma, Evers.
Cyclopides, Hb.
pulchra, Leech
abax, Obth.
houangty, Obth.
silvius, Knoch
palæmon, Pall.
*ab.* aurantia, Tutt
*ab.* excessa, Tutt
*ab.* restricta, Tutt
*ab.* lutea-excessa, Tutt
*ab.* lutea-restricta, Tutt
*ab.* melicertes, Schultz (esperi, Tutt)
*ab.* circumcincta, Tutt
*var.* (et *ab.*) albiguttata, Chr.
*var.* mandan, Edw.
*var.* mesapano, Scudd.
*var.* skada, Edw.
Heteropterus, Dum.
morpheus, Pall.
Leptalina, Mab.
unicolor, Brem.
*ab.* ornatus, Brem.
Dejeania, Obth.
bicolor, Obth.
Apostictopterus, Leech
fuliginosus, Leech
THYMELICINÆ.
THYMELICIDI.
Adopæa, Billberg
lineola, Ochs.
*ab.* pallida, Tutt
*ab.* clara, Tutt
*ab.* brunnea, Tutt
*ab.* suffusa, Tutt
*ab.* ludoviciæ, Mab.
*ab.* semicolon, Staud.
*ab.* intermedia, Tutt
*var.* (et *ab.*) major, Tutt
*ab.* major-clara, Tutt
flava, Brünnich
*ab.* pallida, Tutt
*ab.* pallida-virescens, Tutt
*ab.* suffusa*, Tutt
*ab.* suffusa-virescens, Tutt
*ab.* reversa, Tutt
*ab.* obscura, Tutt
*var.* iberica, Tutt
*var.* syriaca, Tutt
*var.* (et *ab.*) major, Tutt
Thymelicus, Hübner
sylvatica, Brem.
*var.* occidentalis, Leech
hyrax, Led.
leonina, Butl.
*var.* astigmata, Leech
nervulata, Mab.
stigma, Staud.
hamza, Obth.
christi, Rebel
acteon, Rott.
*ab.* virescens, Tutt
*ab.* distincta, Tutt
*ab.* obsoleta, Tutt
*ab.* clara, Tutt
*ab.* extensa, Tutt
URBICOLINÆ.
URBICOLIDI.
Urbicola, [Linn.,] Barb.
comma, Linn.
*ab.* clara, Tutt
*ab.* intermedia, Tutt
*ab.* suffusa, Tutt
*ab.* pallidapuncta, Tutt
*ab.* extrema, Tutt
*ab.* conflua, Tutt
*ab.* juncta, Tutt
*ab.* centripuncta, Tutt
*var.* (et *ab.*) flava, Tutt
*var.* (et *ab.*) pallida, Tutt
*var.* dimila, Moore
*var.* (et *ab.*) catena, Heyd.
*var.* (et *ab.*) alpina, Bath
*var.* florinda, Butl.
*var.* mixta, Alph.
*var.* manitoba, Scudd.
*var.* colorado, Scudd.
*var.* idaho, Edw.
*var.* oregonia, Edw.
*var.* nevada, Edw.
*var.* laurentina, Lyman
*var.* assiniboia, Lyman
*var.* manitoboides, Fletch.
*var.* columbia, Scudd.
*var.* juba, Scudd.
*var.* viridis, Edw.
Augiades, Hb.
bouddha, Mab.
similis, Leech
sylvanoides, Leech
subhyalina, Brem.
*var.* thibetana, Obth.
sylvanus, Esp.
*ab.* paupera, Tutt
*ab.* obsoleta, Tutt
*ab.* opposita, Tutt
*ab.* clara, Tutt
*ab.* extensa, Tutt
*ab.* juncta, Tutt
*ab.* obscura, Tutt
*var.* norvegica, Tutt
*var.* (et *ab.*) anatolica, Plötz
*var.* hyrcana, Christ.
*var.* (et *ab.*) venata, Brem.
*var.* tochrana, Rühl
*var.* (an *spec.*) faunus, Turati
ochracea, Brem.
Halpe, Moore
lucasii, Mab.
varia, Murr.

* Owing to a slip (*anteà*, p. 107), *A. flava* ab. *suffusa* is said to be a parallel form with *A. lineola* ab. *suffusa*. This is wrong, as it is parallel with *A. lineola* ab. *brunnea*. It is *A. flava* ab. *obscura* that is parallel with *A. lineola* ab. *suffusa*.

Padraona, Moore
dara, Koll.
Gegenes, Hübn.
nostrodamus, Fab.
Baoris, Moore
zelleri, Led.
? thyone, Leech
pellucida, Murr.
jansonis, Butl.
Parnara, Moore
bada, Moore
guttatus, Brem.
Chapra, Moore
mathias, Fab.
alcides, H.-Sch.
*var.* ahriman, Chr.
cœrulescens, Mab.
Ismenidæ.
Ismeninæ.
Ismenidi.
Ismene, Swains.
aquilina, Spr.
? jankowskii, Obth.
Hasora, Moore
anura, Nicév.
Rhopalocampta, Wallgrn.
benjamini, Guér.

## Superfamily II: Ruralides.

The "Coppers," "Blues," and "Hairstreaks," as one of the chief groups of this superfamily is popularly called, are closely united by marked oval, larval, pupal, and imaginal characters, and, in their wider relations, are found to show considerable connection with the other main group, the Erycinids. The earlier authors referred our only European species of the latter group, *Hamearis* (*Nemeobius*) *lucina*, on account of its superficial resemblance to the Melitæas, to Linné's *Hamadryades*, but its structural details lead one to include it among the Erycinids (also known as Lemoniids and Riodinids), a family particularly abundant in tropical America, but with some species in North America and the Malay region. Scudder has worked out, in considerable detail, the similarities and the differences of the two groups under the name *Lycaenidae*, treating these as subfamilies, *Lemoniinae* and *Lycaeninae*. He says (*Butts. of New England*, ii., p. 771): "In the perfect stage we find important characters common to these two groups, and distinguishing them from the rest of the butterfly world. Their small size and delicate structure would at once be remarked; the front of the head between the eyes is much narrower than high, which is not true of any other group; the eyes are not in the least prominent, they are notched on the inner margin above to give room for the antennal sockets, which the narrowness of the head between the eyes here renders necessary. As all these are characters which concern the fundamental structure of the head, and are not found elsewhere, they must be regarded as of considerable taxonomic weight. The antennæ, including the club, are invariably straight, with none of the curves so common elsewhere, and especially in the lower groups. Both of the subfamilies agree with the Nymphalids in the slight separation of the meso- and metathorax. The neuration of the wings is extremely simple. The structure of the front legs has been so often insisted upon, that it is not necessary to more than mention it, but it should be borne in mind that the difference between the two subfamilies is comparatively slight, while they both differ from all other butterflies in the broad fact that the front legs of the ♂ are, and those of the ♀ are not, aborted; in no other group, excepting in the single aberrant subfamily, *Libytheinae* (on that account placed here by Bates), are the legs sexually heteromorphous, while here it is universal, though varying in degree. The difference between the two subfamilies is one of degree, the difference between it and other families is one of independent character. Add to this the unique character of the

abdominal appendages of the ♂, shared by both the subfamilies, and we have a totality of characters, drawn from all stages, held by these two groups in common, and in distinction from others, which cannot be exceeded by any other combination of subfamilies in a homogeneous whole." Kirby, however (*Handbook*, etc., p. 7), commenting on this, says that "there are many differences between the two groups thus united by Scudder, and even in pattern and general appearance they are so dissimilar, that there are very few species belonging to either of them which would be likely to be mistaken for the other, even at the first glance, by anyone who was fairly well acquainted with the general appearance of butterflies." He adds that "the Lemoniids and Lycænids may be taken as, in some measure, representative of separate faunas, for the Lemoniids, with the exception of a few somewhat aberrant Old World genera, are almost entirely confined to tropical America, whilst the Lycænids are almost entirely an Old World group, if we except the tropical American species allied to *Thecla*."

Chapman, dealing with the phylogeny of the *Ruralides* from the standpoint of pupal structure, comes, however, to exactly the same conclusion as Scudder. He says that, amongst butterfly pupæ, above the Urbicolids, there appear to be two great divisions, one containing the *Papilionides* (with their Pierid and Nymphalid derivatives), the other containing the *Ruralides* (*Ruralidae* or *Lycaenidae* and *Erycinidae*). There has been so much specialisation in various (and often in parallel) directions in these two groups, that exceptional pupæ may seem to travel far from that typical of the group to which they belong. Still the broad differences are nearly always present, the pupa of the Ruralid group is distinguishable from that of the Papilionid by the short, squat, rounded form, and by the head being quite on the ventral aspect of the pupa, as if the round squat form had been gained by pushing both extremities underneath; they are further distinguishable in that the Papilionids have horns and processes that are part of the pupa itself, but rarely, if ever, any hairs, whilst the Ruralid pupa has always hairs more or less in evidence, though it may occasionally have pupal processes also, like those of Papilionids. When we come to differentiate the *Ruralides* into their two great divisions of *Ruralidae* (*Lycaenidae*) and *Erycinidae*, there is no character that seems to be constant. The Erycinid pupa has the 2nd leg well developed upwards, so as to reach the face (eye) and separate the 1st leg from the antenna, whilst in that of the Lycænids the 1st leg is best developed upwards, its base stretching right across the face and touching the antenna, so that the 2nd leg does not reach upwards to the face. As a rule, the Lycænid pupa is high, whilst, in many Erycinids, the pupa is very flattened, making them often show, with exaggerated conspicuousness, the width across the 3rd and 4th abdominal segments, which distinguishes many pupæ of this group from those of the Papilionid stirps. The pupa of *Hamearis* (*Nemeobius*) *lucina*, our only British Erycinid, might, however, so far as this character is concerned, be a Lycænid. All the Lycænid pupæ, so far examined by me, have been completely solid, without movement; it is probable, however, that in some of the less specialised Lycænid subfamilies, forms retaining movement occur, since, in the *Erycinidae*, the *Euselasiinae* have the normal two movable segments, the *Lemoniinae* have one, whilst in the *Hamearinae* (*Nemeobiinae*), as exemplified by *Hamearis* (*Nemeobius*) *lucina*, the pupa is solid, as in the Lycænids.

Scudder further says that the larvæ may be at once distinguished from all others by the small size of the head, their more or less onisciform, and never elongate, shape, and by the brevity of their legs and prolegs, forcing some of them to glide rather than to creep. Not a few are known to avail themselves of their small head, extensible neck, and oblique position of the mouth, to burrow into pods, seeds, and fruits. The larva, as it leaves the egg, is, in both of the divisions of the group, distinguished by the presence of chitinous annuli or lenticular elevations, serially arranged on the dorsal side of the body. This character they appear to share with the Urbicolids, in which, however, the position is somewhat different. The onisciform shape of the Ruralid (Lycænid) branch makes these recognisable at a glance, but even when they are cylindrical they differ from those of every other group in their abbreviated form. In the Lemoniid (Erycinid) branch there is greater variability of form, but none of the great elongation of the body, characteristic of the other families, is to be observed; in both groups they differ from most other larvæ, and agree together in the incomplete structure of the posterior part of the head, the chitinous skull presenting here no downward slope, the softer membrane of the succeeding segment being attached to near the summit of the head, so that the head becomes more or less retractile, sometimes, certainly to a very slight degree, within the prothoracic segment, while the head itself has a very decided obliquity.

The egg appears to be, throughout the group, uniformly broader than high, a character, however, that it shares with the typical section of the Urbicolids and the Parnassiids; oblate spheroidal in shape, often much flattened, becoming, in its extreme forms, echinoid, tiarate, or turban-shaped in general appearance. Scudder says that the agreement of the Lycænids and Lemoniids in the characters of their eggs, is so complete, that it is impossible, with the limited knowledge of the Lemoniid eggs at disposal, to formulate any satisfactory diagnostic distinctions. In the solitary European representative of the Erycinids (Lemoniids), however, *i.e.*, *Hamearis* (*Nemeobius*) *lucina*, the sculpture is very different from that of the general type presented by the Palæarctic Lycænids.

Chapman further finds that the antennæ of the two Ruralid groups offer considerable resemblance. He writes (*in litt.*) that the antennæ of the Lycænids and Erycinids only differ in degree, the simpler forms being very much alike, with cylindrical joints and sense-hairs generally distributed over the unscaled area, and with the bristles arranged chiefly in a terminal circle on each joint, as in Urbicolids. In a large proportion, however, of Erycinids (Lemoniids) there is a more or less developed ventral groove, which resembles that of Papilios, and differs from that of Pierids and Nymphalids, in that the fine sense-hairs are found outside, as well as within, the groove, whilst, in the two latter families (both of which have grooved antennæ), the sense-hairs are confined to the grooves. The Lycænids, therefore, have preserved throughout a form of antenna that is only found in those Papilionids and Erycinids (Lemoniids) that have these organs least specialised. Though specialising as much, perhaps, as these other families in many other ways, they were satisfied with very little modification in their antennæ. (See also *Nov. Zool.*, v., p. 374.)

Scudder gives the following diagnosis of the superfamily (*Butts. of New England*, ii., pp. 767-768):—

Imago.—Of small size. Head rather small; front always higher than broad, usually half as high again as broad; vertex separated, sometimes partly, sometimes wholly, from occiput by a transverse sulcation; the eyes neither prominent nor projecting beyond the general contour of the head. Tongue inserted below the middle of the lower half of the eye; papillæ of tongue very long and slender, polyhedral, equal, the angles terminating at the truncate or hollowed tip in acicular points, the central process exceedingly slender, blunt tipped; they are attached close to the outer edge of the tongue, confined to the apical tenth or thereabouts, and are always separated from each other by at least half their own length. Antennæ inserted in distinct pits, so far at the side as to infringe upon the eyes. the middle in direct continuation with the sides of the front; the club straight. Labial palpi very slender, cylindrical, of nearly uniform diameter. Prothoracic lobes reduced to a mere lamina. Thorax moderately slender, not much compressed, the upper surface moderately arched, sometimes a little less so above; mesoscutellum pretty large, lozenge-shaped, forming about a right-angle between the halves of the mesoscutum into which it does not greatly project, the suture between the two slight, the two pieces together forming posteriorly a reversed blunt cone; metathorax only slightly separated from the mesothorax. Wings almost always broad and short, the forewings almost invariably simple, the hindwings frequently with thread-like tails. Forewings: costal nervure terminating at from a little less than half to about two-thirds the distance from the base to the apex of the costal margin; subcostal nervure with two or three superior, and one inferior, branches; all simple, excepting the last superior, which is frequently forked; at least one of the superior branches is emitted before the tip of the cell, and the third, when present, beyond; the inferior nervule, united to the nervure by a very slender vein; the nervure itself terminates below the apex of the wing; cell closed by a slender vein, sometimes almost obsolete; median nervure with three branches, itself not reaching the border; internal nervure short, running into the submedian nervure close to the base. Hindwings: costal nervure terminating at or near the middle of the apex of the costal margin, sometimes emitting upward from near the base, a curved precostal shoot; subcostal nervure with three branches, itself not reaching the border, the third nervule connected at its base by an exceedingly slender vein, such as closes the cell; median nervure with three branches, itself not reaching the border; submedian nervure terminating at or just without the anal angle; internal nervure terminating generally near the middle of the lower margin. Forelegs of the female like the other legs, although with less profuse armature and with naked tibial spines; of the male shorter, and either the armature and joints as in the female, excepting on the last joint, where all the apical armature is wanting, and, in their place, generally a single, triangular, slightly curving, median hook; or the tarsi are one-jointed, and entirely devoid of armature. Genital organs: Eighth dorsal segment of male abdomen entire on posterior margin, the upper organ mesially cleft, and the sides variously developed, but usually much expanded, with a pair of slender, tapering, elbowed or strongly arcuate arms attached to the base, and with no median hook; clasps forming slender and elongated or else tapering blades, sometimes bristled at the tip, the intromittent organ long and slender, often to an excessive degree.

Ovum.—Tiarate or oblate spheroidal in shape, more or less deeply and densely reticulate, the angles of the reticulations often filamentous or spiny, the micropyle frequently sunken in an abrupt pit.

Larva (newly-hatched).—Head generally smaller, never larger than the succeeding segments, smooth, generally with few hairs on the lower half, and none on the upper, the posterior margin encroached on by the softer integument behind, so as not to extend behind the summit of the head in a downward curve. Body cylindrical or subcylindrical, generally largest anteriorly, and tapering from the very front backward, furnished with long, longitudinally ranged, tapering, spiculiferous, cuticular appendages, sometimes as long as the body, and with a larger or smaller number of longitudinally ranged, larger or smaller, chitinous annuli or smooth lenticular elevations. First and last body segments, and sometimes others, with a corneous dorsal shield. Larva (adult).—Head smaller, generally much smaller, than the body, oblique, the mouth being thrust forward, with only few hairs on minute papillæ, without tubercles or spines, with scarcely any or no posterior contractions of the

cranium, often completely retractile within the segment behind. Body onisciform or subonisciform, never elongate, often long-ovate, the sides sometimes tectiform, furnished with longer or shorter pile, among which are sometimes longer, longitudinally ranged, hairs or bristles; never spined, but occasionally furnished with fleshy or filamentous processes longitudinally arranged or confined to the 1st thoracic or 8th abdominal segments. Legs and prolegs generally short.

PUPA.—Fastened by a silken girth around the middle, and by cremastral hooks to a silken pad at the tail, in almost any position, but with the head never lower or much lower than the tail, and always in close embrace of the surface. With rare possible exceptions (Bar), never enclosed in more of a cell than the loose attachment of the flaring edges of a leaf might give. Short, stout, compact, rounded, with no angular, and few rounded, prominences, in front bluntly rounded, though sometimes feebly emarginate, the ventral surface almost perfectly flat; head wholly upon the ventral surface, invisible from above; prothorax large.

As has been already noticed, the Erycinids (Lemoniids) are characteristic of the New World, the Ruralids (Lycænids) of the Old World, and are found in the tropical parts of each, rather than the temperate, although the Lycænids of the Old World form a fair proportion of the temperate butterfly fauna, confined in these cases, however, to a few tribal forms. In North America the Lycænids are poorly represented except on the western coast, being elsewhere much overshadowed by the numbers of the Nymphalids and Urbicolids.

The imagines are, on the whole, smaller than those of any other large group, except, perhaps, the Urbicolids, which are also in many species comparatively small; they are, however, usually brightly tinted, and often exceedingly brilliant in hue. Scudder says that their delicate and brilliant markings, together with the nimble and varied flight of many, scarcely excelled by the most vivacious of the Nymphalids, mark them as gems in the lepidopterous world. Their wings are almost always entire, excepting when the inner half of the hindwing develops a tail, often of excessive length and delicacy, a mere thread of colour.

Scudder gives the following diagnostic comparison of the two families that comprise the superfamily *Ruralides*:—

EGG.—Converging septæ extending from walls of cells towards their centre ERYCINIDÆ (LEMONIIDÆ).

No converging septæ thrown off from walls of cells RURALIDÆ (LYCÆNIDÆ).

LARVA (newly-hatched).—Body with chitinous, dorsal, and substigmatal shields on every segment, in which the haired papillæ are confined, and only subdorsal annuli .. .. .. .. .. ERYCINIDÆ (LEMONIIDÆ).

Body with chitinous shields of greater or less extent and distinctness, only on first thoracic and last abdominal segments, no substigmatal shields, and with annuli on the sides of the body .. RURALIDÆ (LYCÆNIDÆ).

LARVA (adult).—Head at least half as broad as the middle of the body; the latter scarcely onisciform .. .. .. ERYCINIDÆ (LEMONIIDÆ).

Head less, generally far less, than half as broad as the middle of the body; the latter more or less onisciform .. RURALIDÆ (LYCÆNIDÆ).

PUPA.—Body elongate, sparsely clothed with long hairs ERYCINIDÆ (LEMONIIDÆ).

Body contracted, sparsely or densely clothed with short hairs or other dermal appendages .. .. .. .. RURALIDÆ (LYCÆNIDÆ).

IMAGO.—Labial palpi minute, only the minute apical joint surpassing the face; forewings provided with a distinct internal nervure; hindwings scarcely channeled to receive the abdomen, furnished with a precostal nervure, the costal nervure only running to the middle of the costal margin; fore tarsi of ♂ with rare exceptions, without spines or claws ERYCINIDÆ (LEMONIIDÆ).

Labial palpi well-developed, porrect, half or more of the middle joint surpassing the face; forewings with excessively brief, hardly perceptible,

internal nervure; hindwings channeled on basal half to receive the abdomen, without a precostal nervure, the costal nervure running nearly to the end of the costal margin; fore tarsi of ♂ armed abundantly beneath and at tip with spines .. .. .. .. RURALIDÆ (LYCÆNIDÆ).

The superfamily is generally known as the *Lycaenides*, a name derived from the Fabrician *Lycaena*, but it is puzzling to understand why the much older Linnean name has been passed over. As already noted (*anteà*, p. 82), Linné, in 1758, united (*Syst. Nat.*, 10th ed., pp. 482 *et seq.*) the "hairstreaks," "blues," "coppers," and "skippers," under the name *Plebeii*, separating, however, the three first-named sections as *Rurales* from the "skippers," which he called *Urbicolae*. *Rurales*, therefore, is the oldest name under which the superfamily, we are now considering, was first separated from the allied superfamilies; we, therefore, retain the superfamily name *Ruralides*. Linné's *Rurales* comprised the following species :—

PLEBEII.—RURALES—*Papilio Plebeius Ruralis cupido, betulae, pruni, quercûs, marsyas, thamyras, arion, argus, argiolus, rubi, philocles, temantes, athemon, caricae, phereolus, lysippus* and *virgaureae*.

Scopoli, Fabricius, Borkhausen, Haworth, and others of the early authors, maintained this group name, but the heterogeneous nature of the group was detected by various writers, including Schiffermüller and Denis, Borkhausen, Latreille, Fabricius, etc. In 1763, their subsequent division was foreshadowed by Scopoli (*Ent. Carniolica*, p. 175). He strangely uses the specific names, in a more or less generic form, and the species as varieties, thus :—

RURALES.
- PAPILIO *Pruni*—type*, var. 1, var. 2.
- PAPILIO *Rubi*.
- PAPILIO *Argus*—*arion, argus, argiolus, idas, coridon, alexis* (each with several subvarieties).
- PAPILIO *Virgaurea*—type†, form *a* major.

It will be observed that *Argus* here is used in quite a generic form. It is subdivided, and described by means of a series of seven diagnoses, the first a general diagnosis, the remainder agreeing with the six species afterwards described at length. The want of precision as to varieties, species, and the greater divisions as here exhibited is most interesting.

In 1775, Schiffermüller and Denis (*Schmett. Wien.*, pp. 180-6, *et seq.*) make this "Group II" of their system, and define it as having "woodlouse-shaped larvæ." The group is subdivided into the following sections :—

RUTILI.—Larvæ oblongoscutatæ; imagines of a glittering-gold colour—*virgaureae, hippothoë, chryseis, helle, phlaeas, xanthe, circe*.

POLYOPHTHALMI.—Larvæ gibboscutatæ; imagines with many-ocellated spots—*endymion, daphnis, arion, alcon, acis, damon, damaetas, argiolus, alsus, corydon, adonis, alexis, agestis, argus, aegon, hylas, battus, amyntas*.

SUBCAUDATI.—Larvæ depressoscutatæ; imagines short-tailed—*rubi, betulae, quercûs, pruni, spini*.

We may here note that Borkhausen (*Sys. Bearb.*, i., pp. 134 *et seq.*) divides his Horde V, *Plebeii-Rurales*, into the same three groups (or families as he terms them).

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* "Type" possibly = *w-album*; "var. 1" possibly = *ilicis*; "var. 2" possibly = *pruni*.

† "Type" = *virgaureae*; form *a* major possibly = *hippothoë*.

In 1777, Scopoli provisionally grouped (*Introductio*, etc., pp. 431-3) the butterflies into most incongruous genera, the species being arranged in sections, according as they were marked with (1) silver or golden bands (*Argyreus*), (2) ocellated spots (*Argus*), (3) tails (*Pterourus*), (4) blotches (*Battus*), (5) bands (*Graphium*). The Ruralids ("coppers," "blues," and "hairstreaks") are distributed throughout these groups (genera) in the most remarkable manner.

In 1780, Kluk (*Zwierz. Hist. Nat.*, iv., p. 81), after briefly describing the butterflies in general, says that they are to be grouped in five genera, the last of which is—

Genus V—PLEBEIUS divided into—
RURALES —*Plebeius cupido*, etc.
URBICOLÆ—*Plebeius comma*, etc.

This is the first (and we believe only) occasion in which *Plebeius* was used generically by the early authors.

In 1781, Barbut fixed *betulae* as the type of *Ruralis*. He gives (*Gen. Ins. Linn.*, p. 173) :—

PLEBEII. RURALES—*Ruralis*, example *P.P.R. betulae*, Linn., no. 220.

In 1793, Fabricius (*Ent. Syst.*, iii., p. 258) renamed the Linnean *Plebeii*, calling the group *Hesperia*. He, however, maintained the Linnean subdivisions, calling the combined "coppers," "blues," and "hairstreaks"—*Rurales*.

In 1798, Cuvier refers to certain species as illustrative of the Linnean groups, his 6th group (*f*) being :—

Les Plébéiens—PLEBEII—*Papilio argus*.

In 1801, Schrank described (*Fauna Boica*, pp. 206 *et seq.*) the Linnean *Rurales* under the name *Cupido*. He subdivided the genus into three very natural groups, *viz* :—

CUPIDO.—A. Gold glänzende Schildfalter.
(*a*) The males almost unspotted—*C. virgaureae*, Lin., *hippothoë*. W.V., *chryseis*, W.V., etc.
(*b*) Both sexes spotted—*C. phlaeas*, W.V., *circe*, W.V., etc.
B. Vielaugige Schildfalter.
(*a*) Without reddish-yellow transverse band on underside of hindwings—*C. arion*, Göze, *alcon*, W.V., *acis*, W.V., *damon*, W.V., *damoetas*, W.V., *argiolus*, W.V., *eumedon*, Esp., *corydon*, Scop., *adonis*, W.V., *alexis*, W.V., *agestis*, W.V., *argus*, W.V., *battus*, W.V., *puer*, Schrk., etc.
C. Klein schwänzige Schildfalter—*C. rubi*, W.V., *betulae*, Linn., *quercûs*, Göze, *pruni*, W.V., *spini*, W.V.

In 1802, Latreille (*Hist. Nat.*, iii., pp. 397-8) simply notes the group as :—

PLEBEII (*Cupido*, Schr.).
1. Les petits porte-queue. Example *Papilio pruni*, Lin.
2. Les argus. Example *Papilio argus*, Lin.
3. Les bronzés. Example *Papilio virgaureae*, Lin.

In 1803, Haworth described (*Lep. Brit.*, pp. 37-49) the group under the name *Rurales*, and subdivided it as follows :—

CAUDATÆ.—*Papilio Plebeius Ruralis betulae*, *pruni*, *quercûs*, *rubi*.
CUPREÆ.—*P.P.R. dispar*, *virgaureae*, *chryseis*, *phlaeas*.
CŒRULEÆ.—*P.P.R. arion*, *corydon*, *adonis*, *icarus*, *hyacinthus*, *argus*, *idas*, *artaxerxes*, *argiolus*, *cymon*, *alsus*.

It will be observed that "Cupreæ" and "Cœruleæ" are adaptations of the popular names of "coppers" and "blues."

In 1804, Latreille (*Nouv. Dict. Hist. Nat.*, xxiv., pp. 184-185, pp. 199-200) gives a series of genera with their respective types, of which one is—

Genus Polyommatus—*Hesperia argus*, Fb.

In 1805, Latreille (*Hist. Nat. Crust. et Ins.*, xiv., pp. 116 *et seq.*) uses the genus *Polyommatus* with exactly the same force as *Cupido*, Schrank. He does not even go so far as Schrank in making any subdivisions. In its inception, therefore, *Polyommatus*, Latr., like *Cupido*, Schrk., is identical with *Rurales*, Linn. Latreille's genus is diagnosed as follows:—

Inner margin of hindwings forming a trough for reception of abdomen. Palpi naked at end. Claws of feet very small, hardly perceptible—*Polyommatus betulae*, Linn., *quercûs*, Fab., *pruni*, Fab., *boeticus*, Fab., *rubi*, Linn., *argus*, Fab., *adonis*, Fab., *meleager*, Fab., *corydon*, Fab., *arion*, Fab., *erebus*, Fab., *cyllarus*, Fab., *acis*, Fab., *argiolus*, Fab., *alsus*, Fab., *myopa*, Geoff., *xanthe*, Fab., *phlaeas*, Fab., *virgaureae*, Fab.

As illustrating the genus *Polyommatus*, he figures *P. corydon* (pl. cvii., figs. 1-2).

In 1806, Hübner published his *Tentamen*, in which only one detail is of importance here, *viz.*, the creation of the genus *Rusticus* with type *argus*, Hb. *nec* Linn.

In 1807, Fabricius published (*Illig. Mag.*, vi., pp. 285 *et seq.*) his classification of the butterflies. In this he subdivided the *Rurales* into several groups, of which those that concern us here, are:—

Hesperia.—(*a*) *Hesperia amor, helius, faunus.*
(*b*) *H. vulcanus, marsyas.*
(*c*) *H. boetica, aemon.*
Lycæna.—(*a*) *Hesperia mars, echion.*
(*b*) *H. amyntas, rubi.*
(*c*) *H. meleager, arion, corydon, adonis, ledi, virgaureae, phlaeas.*
Thecla.— *Hesperia betulae, spini, quercûs.*

In 1809,* Latreille (*Gen. Crust. et Insec.*, iv., p. 206) gave the following dissective diagnosis of his genus *Polyommatus*—

I. Alæ posticæ caudatæ vel dentatæ, sinuatæ, aut saltem ad angulum analem productæ.
(1) Genus Thecla, Fab.—*Pap. betulae, spini, cerasi, quercûs*, etc.
(2) Genera Hesperia et Lycæna, Fab., *Pap. boeticus, meleager, rubi, phlaeas, virgaureae*, etc.
II. Alæ inferiores margine postico integro, dentibus caudisve nullis.
(1) Genus Lycæna, Fab.—*Pap. argus, corydon, alsus*, etc.

In 1810, Latreille (*Consid. Gen.*, etc., p. 440) places under the French name "Polyommate," *betulae, quercûs, boeticus, argus*, de Fab.

In 1815, Leach (*Edin. Encycl.*, ix., pt. 1, p. 135) gave the *Lycaenida* as family II of the *Papilionides*, and grouped them under two genera as follows:—

Thecla.—*T. betulae, pruni, quercûs.*
Lycæna.—(*a*) *L. dispar, chryseis, virgaureae, phlaeas, rubi.*
(*b*) *L. corydon, adonis, dorylas, argus, idas, artaxerxes, alsus, argiolus, cymon.*

In 1816, Dalman (*Vetens. Acad. Handl.*, pp. 48 *et seq.*) named his Phalanx IX, *Zephyrus*, another name that had practically the same comprehensive value as the Linnean *Rurales*, the Schrankian *Cupido* and Latreille's *Polyommatus*. He subdivided, however, *Zephyrus*, into the following sections:—

* Scudder wrongly gives the date as 1807 (*Hist. Gen. Butts.*, p. 253).

AUROTIS.—*Z. quercûs, betulae* (type), *pruni, w-album, ilicis.*
HEODES.—*Z. hippothoë, chryseis, virgaureae, phlaeas, helle, garbas, rubi.*
CYANIRIS.—(*a*) *Z. arion, alcon, cyllarus, argianus, argiolus, alsus.*
(*b*) *Z. icarus, adonis, alexis, agestis, eumedon, optilete, battus, argus.*

It will be observed that *Aurotis* is nothing more than the *Thecla* of Fabricius, *i.e.*, *Cupido*, section *e*, of Schrank. *Heodes* is practically identical with section *a* of *Lycaena*, Leach = section *c* of *Cupido*, Schrank. *Cyaniris* separates the "blues" from the "coppers."

Oken, however, in 1815, following Fabricius and Latreille in the use of *Thecla*, utilised (*Lehrb. Zool.*, i., p. 717) *Hesperia* for the "coppers," and followed Latreille in restricting the name *Lycaena* to the "blues," which he subdivides and arranges as follows :—

LYCÆNA (= *Cupido*).—150 species.
I. Underside of the hindwings without reddish-yellow band.
(1) Wings unnotched—*L. arion, alcon, euphemus, erebus, cyllarus, acis* (*semiargus*), *argiolus, damon, alsus, lysimon, pheretes.*
(2) Wings notched—*L. daphnis* (*meleager*).
II. Underside of the hindwings with yellowish transverse band—*L. corydon, dorilas* (*hylas*), *adonis* (*bellargus*), *icaria* (*amandus*), *alexis, eros, orbitulus, agestis, eumedon, admetus, optilete, argus, aegon, hylas* (*baton*), *battus, amyntas* (*argiades*).

HESPERIA.—*H. helle* (*amphidamas*), *circe* (*dorylas*), *thersamon, gordius, hipponoë* (*alciphron*), *chryseis* (*hippothoë*), *eurybia, hippothoë, virgaureae, phleas, ballus, rubi.*

THECLA.—*T. quercûs, baeticus, telicanus, spini, ilicis, aesculi, acaciae, w-album, pruni, betulae.*

In 1816, Ochsenheimer (*Schmett. von Europa*, iv., pp. 24 *et seq.*) uses only the name *Lycaena*, but follows out Oken's subdivisions exactly, adding one or two species, but making no other difference.

In 1817 (February), "R.L." (an anonymous reviewer of Ochsenheimer in *Jena. Allg. Lit. Zeit.*, i., p. 280) uses *Aricia* for Ochsenheimer's family A (the "blues"), *Lycaena* for family B (the "coppers," *Thestor ballus*, and *Callophrys rubi*, etc.), and *Thecla* for family C (other "hairstreaks," etc.).

In the same year (September), Zincken (reviewing the same work in *Allg. Lit. Zeit.*, iii., p. 75) proposes the new name *Chrysoptera* for Ochsenheimer's family viii (B) ("coppers," *Thestor ballus* and *Callophrys rubi*), and *Thecla* for family ix (C) (other "hairstreaks," etc.).

But by far the most important work published, commenced to see the light from about 1816 to 1818, *viz.*, Hübner's *Verzeichniss*. In the *Ruralides*, however, the author did not find quite so clear a field as in the Urbicolids and some other groups, and by a misuse of the name *Lycaena* (of which he erroneously notes *xerodice* as the type, this not being one of the original species), and, dropping all the hitherto-used names, gives a detailed classification under new titles, the part that concerns us here being as follows (pp. 66 *et seq.*) :—

Tribus.—GENTILES.
Stirps 1.—AGRODLÆTI.
Family A.—ADOLESCENTES.
Coitus 1.—EUMÆI—*Eumaeus minyas*, Hb.
Coitus 2.—NOMIADÆ—*Nomiades acis*, Schiff., *Verz.*, Pap. no. 5, Hb., *Pap.*, 269-271. *N. pheretes* (*atys*, Hb., *Pap.*, 495-496, 548-549). *N. damon*, Schiff., *Verz.*, Pap. no. 6 (*biton*, Sulz., *Gesch.*, 18, 9, Hb., *Pap.*, 275-277). *N. damoetas*, Schiff., *Verz.*, Pap. no. 7, Hb., *Pap.*, 266-268. *N. erebus*, Knoch, *Beytr.*, ii., Pap. 4, Hb., *Pap.*, 260-262. *N. alsus*, Schiff., *Verz.*, Pap. no. 9, Hb., *Pap.*, 278-9. *N. alcon*, Schiff., *Verz.*, Pap. no. 4 (*arcas*, Esp., *Pap.*, 34, 4-5, Hb.,

*Pap.*, 263-5). *N. euphemus*, Hb., *Pap.*, 257-9. *N. arion*, Linn., *Syst. Pap.*, 230, Hb., *Pap.*, 254-6. *N. lysimon*, Hb., *Pap.*, 534-5.

Coitus 3.—AGRIADÆ—*Agriades daphnis*, Schiff., *Verz.*, Pap. no. 2 (*et endymion*, no. 1) (*meleager*, Esp., *Pap.*, 45, 2, Hb., *Pap.*, 280-2). *A. cajus*, Cram., 319 D, E. *A. panoptes*, Hb., *Pap.*, 670-3 (? *zachaeus*, Hbst., 311, 9-10). *A. argiolus*, Linn., *Syst. Pap.*, 234 (*acis*, Fab., *Mant. Pap.*, 687. *A. cleobis*, Esp., *Pap.*, 40, 3; Hb., *Pap.*, 272-4). *A. ladon*, Cram., 270, D, E. (et *mycilus*, 282 F, G.). *A. admetus*, Esp., *Pap.*, 82, 2-3, Hb., *Pap.*, 307-309. *A. orbitulus*, Prunn., *Lep.*, 158 (*meleager*, Hb., *Pap.*, 522-5, 761-2). *A. corydon*, Schiff., *Verz.*, Pap. no. 10, Hb., *Pap.*, 286-8. *A. dorylas*, Schiff., *Verz.*, Pap. no. 19 (*hylas*, Esp., *Pap.*, 45, 3, Hb., *Pap.*, 289-291). *A. adonis*, Schiff., *Verz.*, Pap. no. 11 (*bellargus*, Esp., *Pap.*, 32, 3, Hb., *Pap.*, 295-7). *A. golgus*, Hb., *Pap.*, 688-9. *A. agestis*, Schiff., *Verz.*, Pap., no. 13, Hb., *Pap.*, 303-6. *A. eumedon*, Esp., *Pap.*, 52, 2-3, Hb., *Pap.*, 301-2, 700-1. *A. icarius*, Esp., *Pap.*, 99, 4 (*amandus*, Hb., 283-5, 752-5).

Coitus 4.—SCOLITANTIDÆ—*Scolitantides battus*. Schiff., *Verz.*, Pap. no. 17 (*telephii*, Esp., 41, 2, Hb., *Pap.*, 328-330). *S. hylas*, Schiff., *Verz.*, Pap. no. 16 (*amphion*, Esp., *Pap.*, 53, 1, Hb., *Pap.*, 325-7).

Coitus 5.—LYCÆIDÆ—*Lycaeides argus*, Linn., *Syst. Pap.*, 232, Hb., *Pap.*, 316-8. *A. aegon*, Schiff., *Verz.*, Pap. no. 15, Hb., *Pap.*, 313-5. *L. optilete*, Knoch, *Beytr.*, i., Pap. no. 3, Hb., *Pap.*, 310-2. *L. cyparissus*, Hb., *Pap.*, 654-7 (*nanus*, Herbst, 312, 1-2).

Coitus 6.—EVERÆ—*Everes amyntas*, Schiff., *Verz.*, Pap. no. 18 (*tiresias*, Esp., *Pap.*, 34, 1-2, Hb., *Pap.*, 322-4). *E. polysperchon*, Bergst., *Nom.*, 44, 3-5 (*tiresias*, Hb., *Pap.*, 319-321).

Coitus 8.—LAMPIDÆ—*Lampides numerius*, Stoll., 38, 7, 7 G. *L. zethus* (*alexis*, Stoll., 38, 3, 3 C). *L. helius*, Cram., 201 F, G (*esra*, Herbst, 285, 5-6). *L. baalliston*. *L. boeticus*, Linn., *Syst. Pap.*, 226, Hb., *Pap.*, 373-5 (*boetica*, Fab., *Ent. Hesp.*, 77). *L. plato*, Fab., *Ent. Hesp.*, 103. *L. archius*, Cram., 181 C. *L. celerio*, Fab., *Mant. Pap.*, 625 (*celeno*, Cram., 31 C, O). *L. aratus*, Cram., 365 A, B.

Family B.—VILLICANTES.

Coitus 4.—CHRYSOPHANI—*Chrysophanus phlaeas*, Linn., *Syst. Pap.*, 252, Hübn., *Pap.*, 362-363. *C. timeus*, Cram., 186 E, F. *C. helle*, Schiff., *Verz.*, Pap. M, 4 (*amphidamas*, Esp., *Pap.*, 53, 1, Hübn., *Pap.*, 331-3). *C. thersamon*, Esp., *Pap.*, 89, 6 (*xanthe*, Hb., *Pap.*, 346-8). *C. gordius*, Sulz., *Gesch.*, 18, 7-8, Hb., *Pap.*, 343-5. *C. hyllus*, Cram., 43 B, C (*hylla*, Fab., *Spec. Pap.*, 466. *C. hipponoë*, Esp., *Pap.*, 35, 5) *lampetie*, Schiff., *Verz.*, Pap. M, 8, Hb., *Pap.*, 356-9. *C. chryseis*, Schiff., *Verz.*, Pap. M, 3, Hb., *Pap.*, 337, 338, 355. *C. eurybia*, Ochs., *Schm.*, i., 7, 37 (*euridice*, Hb., *Pap.*, 339-342). *C. virgaureae*, Linn., *Syst. Pap.*, 253, Hb., *Pap.*, 349-351. *C. hippothoe*, Linn., *Syst. Pap.*, 254, Hb., *Pap.*, 352-354. *C. circe*, Schiff., *Verz.*, Pap. M, 7, Hb., *Pap.*, 334-336.

Coitus 9.—THESTORES—*Thestor petalus*, Cram., 243, C, D. *T. ballus*, Fabr., *Mant. Pap.*, 729, Hb., *Pap.*, 360, 361, 550.

Family C.—ARMATI.

Coitus 1.—LYCI—*Lycus niphon*, *Zuträge*, 203-4. *L. rubi*, Linn., *Syst. Pap.*, 237, Hb., *Pap.*, 364-5. *L. gryneus* (*damon*, Cram., 390 C, D).

Coitus 2.—STRYMONES—*Strymon mopsus*, Hb., *Zütr.*, 135-136. *S. pruni*, Linn., *Syst. Pap.*, 221, Hb., *Pap.*, 386-387. *S. betulae*, Linn., *Syst. Pap.*, 220, Hb., *Pap.*, 383-4. *S. w-album*, Knoch, *Beytr.*, ii., *Pap.* no. 1, Hb., *Pap.*, 380-1. *S. esculi*, Hb., *Pap.*, 559-560, 690-1. *S. ilicis*, Esp., *Pap.*, 39, 1 *b*, Hb., *Pap.*, 378-9. *S. acaciae*, Fab., *Mant. Pap.*, 655, Hb., *Pap.*, 743-6. *S. melinus*, Hb., *Zütr.*, 121-2. *S. lynceus*, Fab., *Ent. Hesp.*, 73, Hb., *Pap.*, 692-3. *S. spini*, Schiff., *Verz.*, Pap. O, 5, Hb., *Pap.*, 376-7. *S. beon*, Cram., 319 B, C (Hb., *Rust. Arm. Poeas*). *S. pan*, Drur., ii., 23, 4 (*pann*, Fab., *Ent. Hesp.*, 67). *S. mars*, Fab., *Spec. Pap.*, 501 (*acis*, Cram., 175 C, D).

Coitus 4.—BITHYNES—*Bithys tyrrhenus* (*erix*, Cram., 82 B). *B. cubentus*, Cram., 337 F, G. *B. cethegus*, Stoll, 38, 5, 5 E. *B. vesulus*, Cram., 340, J.K. *B. sicheus*, Cram., 144 C, D. *B. lydus* (*eryx*, Cram., 143 D). *B. tephraeus*. *B. leucophaeus*, Hb., *Zütr.*, 87-88. *B. sphinx*,

Fab., *Syst. Pap.*, 329 (*dindymus*, Cram., 46 F, G. *B. strephon*, Fab., *Syst. Pap.*, 344 (*cyllarus*, Cram., 27 C, D. *B. quercûs*, Linn., *Syst. Pap.*, 222, Hb., *Pap.*, 369, 370, 368.

In 1817, Latreille (*Cuvier's Regne Animal*, iii., p. 553) details at length one species as representing *Polyommatus*. He notes it as :—

Polyommatus.—L 'argus bleu, Geoff., Engram., *Pap. Europ.*, xxxviii., no. 80, *g*, *h* (*Papilio alexis*, Hb., lx., pp. 292-294).

In 1818 (*Nouv. Dict.*, new ed., p. 509), he rightly cites to *alexis*, Hb., "l 'argus bleu" of Geoffroy, which he had previously cited to "*argus*," thus showing what he first understood by "*argus*" when he fixed it as the type of *Polyommatus*.

In 1819, Latreille (*Ency. Méth.*, ix., p. 595) again deals with his genus *Polyommatus* (which, he says, comprises the three genera of Fabricius) as follows :—

Polyommatus.—Palpes inférieurs de longueur moyenne ou courts.
Thecla, Fab.—*Papilio betulae, pruni, lynceus*, etc.
Hesperia, Fab.—*Papilio boeticus, telicanus, amyntas*, etc.
Lycæna, Fab.—*P. gordius, phlaeas, virgaureae, alexis, adonis, corydon*, etc.

In the same year, Samouelle (*Ent. Usef. Comp.*, pp. 241-2) following Leach, gives the same subdivisions as the latter, *viz.* :—

Thecla, Fab., Leach (*Polyommatus*, Latr.).—Feet in both sexes all alike, nails scarcely produced beyond the pulvilli, which are large; antennæ gradually clubbed; the club elongate, cylindric oval; hindwings tailed.
(*a*) Antennæ gradually clavated—*Thecla betulae, pruni, quercûs*.
(*b*) Antennæ abruptly clavated—*Thecla rubi*.

Lycæna, Fab., Leach (*Polyommatus*, Latr.).—Legs alike in both sexes; nails projecting beyond the pulvilli, which are small; antennæ with an abrupt club, somewhat ovate, compressed, or spoon-shaped.
(*a*) Hindwings more or less tailed—*Lycaena dispar, chryseis, virgaureae, phlaeas*.
(*b*) Hindwings with the posterior margin entire—*Lycaena corydon, adonis, dorylas, argus, idas, artaxerxes, alsus, argiolus, cymon*.

Overlooking Oken's restriction, and following Leach and Samouelle, we find Curtis, in 1824 (*Illus. Brit. Ent.*, fo. 12), naming *phlaeas* the type of the genus *Lycaena*, an action altogether *ultra vires*, as it had already been restricted to the "blues." In 1829 (*op. cit.*, fo. 264), we find him following Swainson, and naming *betulae* as the type of *Thecla* (Swainson, *Zool. Illus.*, i-ii., p. 69).

In 1828, Stephens (*Illus. Brit. Ent. Haust.*, i., p. 74) groups the family under the name *Lycaenidae*, which he subdivides into the following three genera : –

| | | | | |
|---|---|---|---|---|
| Antennæ | Capitulo haud compresso. | Oculi | pubescentes | Thecla. |
| | | | nudi .. | Lycæna. |
| | Capitulo compresso | .. | .. .. | Polyommatus. |

In these he groups the following species :—

Thecla.—*T. betulae, quercûs, pruni* (=*w-album*), *spini, rubi*.
Lycæna.—*L. phlaeas, chryseis, dispar, hippothoë, virgaureae*.
Polyommatus.—*P. argiolus, alsus, acis, arion, alcon, corydon, adonis, dorylas, icarius, alexis, eros, argus, agestis, artaxerxes*.

In 1832, Boisduval (*Icones*, etc., pp. 43 *et seq.*) groups the section, under the name *Lycaenides* as follows :—

Polyommatus, Latr.—*P. dispar*, Haw., *ottomanus*, Lep., *ballus*, Fab.
Argus.—*A. icarius, escheri, dorylas, eros, calliopis, artaxerxes, aquilo, donzelii, admetus, rippertii, dolus, sebrus, lysimon, melanops, erebus, euphemus, alcon, iolas*.

In 1832, Duponchel (*Hist. Nat.*, supp. i., pp. 387 *et seq.*) gives the following grouping :—

Lycænides, Leach.

Thecla, Fab.—*T. betulae, pruni, w-album, acaciae, aesculi, lynceus, spini, quercûs, evippus, rubi.*

Argus, Bdv.—*A. battus, hylas, aegon, pylaon, barius, calliopis, optilete, pheretes, orbitulus, aquilo, eumedon, agestis, artaxerces, rhymnus, eros, donzellii, alexis, escherii, icarius, adonis, dorylas, corydon, meleager, iolas, arion, erebus, euphemus, alcon, cyllarus, saportae (melanops), lysimon, admetus, damon, dolus, rippertii, acis, sebrus, alsus, argiolus, tiresias, amyntas.*

Lycæna, Fab.—*L. boeticus. telicanus.*

Polyommatus, Latr.—*P. ballus, phlaeas, ottomanus, virgaureae, hippothoë, eurydice, chryseis, hiere, gordius, thersamon, xanthe, helle.*

In 1835, however, Stephens grouped (*Illus. Brit. Ent. Haust.*, iv., app. p. 404) the species after Hübner. as follows :—

Tribus II. Gentiles.

Agrodiæti.

Adolescentes.

Nomiades.—*N. acis, alsus, alcon, arion.*

Agriades.—*A. argiolus, corydon, dorylas, adonis. alexis, agestis, icarius.*

Lycæides.—*L. argus.*

Villicantes.

Chrysophanus. — *C. phlaeas, chryseis, virgaureae, hippothoë.*

Armati.

Lycus.—*L. rubi.*

Strymon.—*S. pruni, betulae, w-album, ? spini.*

Bithys.—*B. quercûs.*

In 1840, Westwood (*Synopsis Genera Brit. Ins.*, p. 88) writes :—

Lycænidæ, Leach (*Polyommatidae*, Swains.).

Thecla, Fab. (*Lycaena* pars, Ochs.). — Club of antennæ elongate; eyes pubescent; hindwings generally tailed—5 species. *P. betulae*, L., Curt. 316.

Lycæna. Fab. (*Polyommatus*, Latr.).—Club of antennæ ovate; eyes naked; hindwings not tailed—5 species. *P. phlaeas*, L., Curt. 12.

Polyommatus, Latr. (*Argus* pars, Scop.).—Club of antennæ abrupt, compressed; eyes pubescent or naked; wings entire; posterior obsoletely denticulated—13 species. *P. arion*, L., Lewin, pl. 37.

In 1844, Herrich-Schäffer gives (*Sys. Bearb.*, i., pp. 111 *et seq.*) the following grouping of the Lycænides, which he still maintains in only three genera :—

Lycæna.

I. Alæ posteriores ecaudatæ.

1. Alæ posteriores subtus sine maculis rubris.

A. Alæ omnes loco ocellorum maculis irregularibus subtransversis albis—*rhymnus*, Evers.

B. Alæ posteriores subtus loco ocellorum maculis magnis ovalibus albis—*pheretes*, Ochs.

C. Alæ posteriores ocellis.

*A*. Alæ posteriores omnino rotundatæ.

a. Alæ subtus ante limbum immaculatæ aut serie duplici macularum obsoletarum nigrarum, exterioribus rotundatis, interioribus lunatis.

α. Loco ocellorum alarum anteriorum strigæ obliquæ—*argiolus*, L.

β. Ocelli rotundati.

1′. Alarum posteriorum ocelli areolarum 2-5 arcum formant extrorsum convexum, 5-7 concavum: aut 2-5 stant linea recta, itidem 5-7.

A′. Alæ posteriores subtus vitta longitudinali media nivea.

*A'*. Alarum posteriorum ocelli anteriorum multo minores—*damon*, Fab., *damocles*, Kef., *epidolus*, Bdv.
*B'*. Ocelli alarum omnium aequales—*donzelii*, Bdv., *rippertii*, Bdv.
B'. Alæ posteriores subtus sine vitta alba.
*A'*. Alarum anteriorum series ocellorum antice a limbo valde recedit—*cyllarus*, Fab., *melanops*, Bdv.
*B'*. Alarum anteriorum series pseudocellorum sinuata, in areola 2 et 6 a limbo remotior ac medio—*acis*, W.V., *dolus*, Hb., *admetus*, Esp.
*C'*. Alarum anteriorum series cum limbo fere parallela—*sebrus*, Bdv., *alsus*, Fab., *jolas*, Ochs.
2'. Alarum posteriorum ocelli areolarum 2-4 linea stant recta, itidem 5-7, at 5 basi multo propior ac 4—*erebus*, Fab.
b. Alæ subtus ante limbum serie duplici macularum nigrarum, interioribus rotundatis, exterioribus obsoletioribus sublunatis—*alcon*, Fab., *euphemus*, Ochs.
c. Alæ anteriores subtus ocello uno aut pluribus intra basin et lunulam mediam, omnes ante limbum serie duplici macularum nigrarum interiores lunatæ, exteriores rotundatæ—*arion*, Linn., *lysimon*, Ochs.
*B*. Alæ posteriores in costa 2 maris angulatæ, in 1*b*, 2 et 3 fœminæ acute dentatæ—*daphnis*, W.V.
2. Subtus ante limbum maculæ rufæ.
A. Inter lunulam mediam et basin alarum anteriorum ocellus unus aut alter.
*A*. Ocellus cellulæ 6 alarum posteriorum linea recta inter ocellos cellulæ 5 et 7 positus.
a. Alæ posteriores subtus inter seriem ocellorum et maculas limbales nulla vitta alba.
α. Alæ posteriores supra sine maculis rubris, anteriores lunula media nigra—*battus*, W.V., *hylas*, W.V. (et var. *panoptes*, Hb.).
β. Alæ posteriores supra maculis rubris a cellula 1*b*, usque ad 3 aut 4. Alæ anteriores lunula media nulla—*bavius*, Evers.
b. Alæ posteriores subtus inter seriem ocellorum et maculas limbales cellulæ 3 et 4 albæ.
α. Ciliæ immaculatæ; alæ anteriores et posteriores subtus concolores—*alexis*, Fab., *eros*, Och., *eroides*, H.-Sch., *boisduvalii*, H.-Sch.
β. Ciliæ (saltem in alis anterioribus) nigro-notatæ, alæ posteriores subtus anterioribus paullo obscuriores—*corydon*, F., *adonis*, F.
*B*. Ocellus areolæ 6 alarum posteriorum multo propior basi ac ocellus cellulæ 5 et 7—*orbitulus*, Esp., *aquilo*, Bdv.
*C*. Ocellus cellulæ 5 alarum posteriorum deest; costæ albido irroratæ—*dardanus*, Friv.
B. Alæ anteriores subtus a basi usque ad maculam mediam innotatæ.
*A*. Maculæ limbales exteriores nigræ, non argenteo-nitidæ.
a. Subtus a basi alarum posteriorum vitta alba inter ocellos cellulæ 3 et 4 ad limbum currit.
b. A macula media alarum posteriorum vitta alba inter ocellos cellulæ 4 et 5 ad limbum currit—*eumedon*, Ochs.
c. Alæ posteriores inter oculos cellulæ 3 et 4 maculasque limbales albæ.
α. Alæ anteriores supra macula media nivea—*artaxerxes*, Fab.
β. Supra macula media nivea nulla.

1'. Oculus cellulæ 6 alarum posteriorum basi multo propior ac oculi cellularum 5 et 7.

*A.'* Mas et foemina fusca—*agestis*, W.V., *idas*, Ramb.

*B'.* Masargenteo-coeruleus—*anteros*, Kind.

2'. Oculi cellularum 5 et 7 linea stant recta aut subrecta.

A'. Alæ omnes subtus maculis laete rubris.

*A'.* Ciliæ innotatæ—*dorylas*, Hb.

*B'.* Ciliæ subtus ad basin in costis nigropunctatæ—*escheri*, Hb., *hesperica*, Ramb.

B'. Subtus vix rudimentum macularum rubrarum—*admetus* (wegen der kaum zu erkennenden rothen Flecke der Unterseite schon p. 116 aufgezählt).

d. Alæ posticæ sine maculis et vittis albis—*icarius*, Esp. (*amandus*, Hb.), *bellis*, Friv.

B. Maculæ limbales externæ in alis posterioribus cœruleo-argenteonitidæ.

a. Subtus maculæ rubræ alarum posteriorum cellulas 1*b*-7 occupant, alarum anteriorum cellulas 1*b*-6.

α. Tibiæ anticæ inermes—*zephyrus*, Friv., *argus*, Linn.

β. Tibiæ anticæ processu apicali uncinato—*aegon*, Bork., *bella*, Bisch.

b. Subtus maculæ rubræ alarum posticarum solum cellulas 1*c*, 2-3 occupant.

α. Ocelli omnes nigerrimi.

1'. Alæ posticæ omnino rotundatæ—*optilete*, F.

2'. Alæ posteriores in costa 2 dentatæ—*fischeri*, Evers.

β. Ocelli seriei alarum posteriorum fundo non obscuriores—*trochilus*, Friv.

II. Alæ posteriores in costa 2 caudatæ.

1. Alæ omnes lunula media subtus crassa; ocelli cellularum 2 et 6 alarum omnium basi propinquiores—*psittacus*, Friv.
2. Alæ omnes lunula media subtus tenui, ocellorum series fere recta—*amyntas*, F.
3. Alæ subtus nec ocellis nec lunula media—*telicanus*, Hbst., *baetica*, Linn.

Polyommatus, Bdv.

I. Alæ posteriores subtus serie duplici macularum limbalium, fasciam rubram includentibus.

1. Subtus in alis anterioribus ocellus 1 aut 2 inter basin et seriem oculorum in cellula 1*b*; lunulæ limbales intus niveo cinctæ—*helle*, F.
2. Subtus in alis anterioribus basin versus præter oculos cellulæ mediæ nullus oculus, lunulæ limbales intus nunquam albo cinctæ.

A. Subtus ocelli alarum cellularum anteriorum 1*b*-7 per paria verticaliter positi.

*A.* Subtus maculæ limbales in duplici serie alas omnes percurrunt—*circe*, W.V., *thersamon*, F. (*xanthe*, Hb.).

*B.* Subtus maculæ limbales externæ solum in alis posterioribus—*gordius*, Esp., *hipponoë*, Esp.

B. Subtus ocellis alarum anteriorum cellularum 1*b*-4 in lineam fere rectam positis, solum ocello cellulæ 3 basi parum propiore.

*A.* Alæ posteriores subtus griseæ—*chryseis*, F., *eurybia*, O., *candens*, Bisch.

*B.* Alæ posteriores subtus cinereæ basi late cœrulescentes—*hippothoë*, L.

II. Alæ posteriores subtus ante limbum sine maculis nigris fasciam rubram includentibus.

1. Alæ posticæ subtus ocellis regulariter pallidius cinctis, versus limbum obscuriores, lunulis aurantiacis—*ottomanus*, L.
2. Alæ posteriores subtus ocellis perparvis, solum extrorsum pallidius cinctis—*virgaureae*, L., *phlaeas*, L.

THECLA, Fab.

I. Supra fuscæ, non cœruleæ.

1. Alæ posteriores ecaudatæ; subtus virides.

A. Alæ posteriores subtus violaceo-cinereæ basi latissime virides, ante limbum serie plerumque triplici punctorum minimorum alborum—*ballus*, F.

B. Alæ omnes subtus læte virides—*rubi*, L.

2. Alæ posteriores in costa 2 cauda apice alba.

A. Subtus fuscæ aut griseæ.

*A*. Alarum posteriorum fascia limbalis rubra in cellula 1*c* omnino cœrulea—*spini*, F.

*B*. Alarum posteriorum fascia limbalis rubra etiam cellulam 1*c* percurrit.

a. Linea alba alarum posteriorum a margine anteriore usque ad costam 2 fere recta—*pruni*, L., *w-album*, Kn.

b. Linea alba alarum posteriorum inter marginem anteriorem et costam 2 irregulariter fracta et interrupta.

α. Hujus lineæ partes singuli subrecti—*acaciae*, F.

β. Hujus lineæ partes, præsertim in alis anterioribus et in cellula 1*c* alarum posteriorum angulati—*ilicis*, O., *aesculi*, O.

*C*. Subtus aurantiaca—*betulae*, L.

II. Supra cœruleæ aut cœruleo-nigricantes—*quercûs*, L., *roboris*, Esp.

In 1845, Duponchel slightly modified (*Cat. Méth.*, pp. 28 *et seq.*) his previous grouping of the Lycænids, and gives:—

THECLA, Fab.

A. Ailes inférieures avec une queue—*betulae*, L., *pruni*, L., *w-album*, Ill., *acaciae*, F., *aesculi*, H., *lynceus*, F. (*ilicis*, H.), *spini*, F. (*lynceus*, Esp.), *quercûs*, L.

B. Ailes inférieures sans queue—*evippus*, Ill. (*roboris*, Esp.), *rubi*, L.

POLYOMMATUS, Bdv.—*ballus*, F., *phlaeas*, L., *ottomanus*, Lef., *virgaureae*, L., *hippothoe*, L., *eurydice*, H., *chryseis*, F., *hiere*, F., (*hipponoë*, O.), *gordius*, Esp., *thersamon*, F., *xanthe*, F. (*circe*, Ill.), *helle*, F.

LYCÆNA, Bdv.

A. Ailes inférieures munies d'une queue linéaire—*boetica*, L., *telicanus*, Hbst. (*boeticus*, Esp.), *amyntas*, F., *fischeri*, Evers.

B. Ailes inférieures sans queue.

*a*. Sans lunules fauves marginales—*argiolus*, L., *sebrus*, B., *alsus*, F., *acis*, W.V., *melanops*, B., *lysimon*, H., *cyllarus*, F., *alcon*, F., *euphemus*, H., *erebus*, F., *arion*, L., *meleager*, Esp., *iolas*, H., *admetus*, Esp., *rippertii*, B., *damone*, Evers., *damon*, F., *dolus*, H., *epidolus*, B., *donzelii*, B., *orbitulus*, Esp., *aquilo*, B., *pheretes*, O., *pheretiades*, Evers.

*b*. Avec des lunules fauves marginales, en dessus ou en dessous—*hylas*, F., *battus*, F., *bavius*, Evers., *aegon*, Bkh., *argus*, L., *optilete*, F., *coelestina*, Evers., *eumedon*, Esp., *idas*, Ramb., *artaxerces*, F., *agestis*, Esp., *pylaon*, Fisch., *rhymnus*, Evers., *eros*, O., *everos*, Kinder., *anteros*, Kinder., *alexis*, F., *escheri*, H., *hesperica*, Ramb., *cyane*, Evers., *icarius*, Esp., *adonis*, F., *dorylas*, H., *corydon*, F.

In 1850, Stephens (*List*, pp. 16 *et seq.*) gives the following grouping:—

LYCÆNIDÆ.

THECLA.

*Strymon betulae, pruni, w-album.*

*Bithys quercûs.*

*Lycus rubi.*

CHRYSOPHANUS.—*C. phlaeas, virgaureae, chryseis, hippothoë, dispar.*

POLYOMMATUS.

*Pithecops argiolus.*

*Nomiades alsus, acis, arion.*

*Agriades corydon, adonis, alexis.*

*Lycaeides aegon, agestis, salmacis, artaxerxes.*

The later historical material bearing on this group is of little importance either in showing the origin of the family, subfamily, tribal or generic names, which, by 1850, were all practically settled so far as our Palæarctic fauna is concerned. We have, therefore, only to add our summary of the data used in fixing the types of the genera that we shall be called upon to consider in the systematic part of our work that follows. These genera and their types are :—

[1758] 1780. Plebeius, [Linné,] Kluk.—First used in generic sense by Kluk in 1780. Heterotypical. Crotch, in 1872, erroneously states that Cuvier, in 1799, fixed *argus* as type, but Cuvier does not use the name generically. Besides Crotch's indication, Kirby, in 1896, fixed the type as *argus* (*aegon*).

[1758] 1781. Ruralis, [Linné,] Barbut.—Heterotypical in its use by Linné. Type fixed as *betulae* by Barbut in 1781.

1801. Cupido, Schrank.—Heterotypical. Type fixed in 1870 by Kirby as *alsus* (which, he says, is included in Schrank's *puer* as ♀ of that species). Schrank's ♂ *puer* is a tailed species = *argiades*. *Alsus* (= *minima*) accepted as type by Tutt, in 1896.

1804. Polyommatus, Latreille.—Genus founded independently to cover exactly the same ground as *Cupido*. Type fixed in 1804 as *argus* (= *icarus*) by Latreille. Confirmed by Latreille in 1817 as *icarus*, with reference to Hübner, figs. 292-4.

1806. Rusticus, Hübner.—Created solely for *argus*, Hb. (*argyrognomon*), which is therefore the type. Falls before *Plebeius*, [Linné,] Kluk.

1807. Thecla, Fabricius.—Heterotypical. Type fixed in 1821 by Swainson as *betulae*, Linn. Confirmed by Curtis in 1829, and by Westwood in 1840. Falls therefore as a synonym of *Ruralis*, [Linné,] Barbut.

1807. Lycæna, Fabricius.—Heterotypical, containing "blues" and "coppers." Restricted by Latreille in 1809 to the untailed "blues," and by Oken in 1815 to the "blues." Type fixed in 1824 by Curtis as *phlaeas*, but this action *ultra vires* in face of previous restriction. Type fixed in 1838 as *arion* by Thon.

1816. Zephyrus, Dalman.—Type fixed by Dalman as *betulae*, therefore falls as a synonym of *Thecla*, Fab., and *Ruralis*, [Linné,] Barbut.

1816. Aurotis, Dalman.—Dalman's section of *Zephyrus* containing *betulae*, therefore falls as a synonym of *Zephyrus*, Dalm., *Thecla*, Fab., and *Ruralis*, [Linné,] Barbut.

1816. Heodes, Dalman.—Only *virgaureae* cited in the generic synopsis (p. 63), therefore this is the type.

1816. Cyaniris, Dalman.—Only *argianus* (= *semiargus*) cited in the generic synopsis (p. 63), therefore this is the type.

1817. Aricia, R. L.—Created for Ochsenheimer's fam. A, the "blues." Used by Herrich-Schäffer in 1839 for *agestis* (*astrarche*), which must, therefore, be taken as the type.

1817. Chrysoptera, Zincken.—Created for Ochsenheimer's fam. viii and fam. ix, "coppers" and "hairstreaks." *Virgaureae* should be taken as the type, this being the species of which the larva was best known to Schiffermüller and Ochsenheimer, both of whom use the larval characters in their diagnosis of the section. Falls as a synonym of *Heodes*, Dalm.

1818 *circa*. Hamearis, Hübner.—Heterotypical. Type designated *lucina* by Curtis in 1830, confirmed by Westwood in 1840.

1818 *circa*. Nomiades, Hübner.—Heterotypical. Restricted by Stephens in 1835 to *acis*, *alsus*, *alcon* and *arion*. Type fixed in 1873 by Scudder as *semiargus* (*acis*). Therefore falls as a synonym of *Cyaniris*, Dalman.

1818 *circa*. Agriades, Hübner.—Heterotypical. Restricted by Stephens in 1835 to *argiolus*, *corydon*, *adonis*, *alexis*, *agestis*, *dorylas* and *icarius*. Doubtfully restricted further in 1858 by Kirby to *corydon* and *astrarche* (*agestis*). Stephens' restriction renders Scudder's action, in 1875, of fixing *orbitulus* as type, *ultra vires*. We would suggest *corydon* as type.

1818 *circa*. Lycæides, Hübner.—Contains *argus* (*argyrognomon*) the type of Hübner's genus *Rusticus*, of which it is therefore a synonym. Falls also before *Plebeius*.

1818 *circa*. Everes, Hübner.—Created for *amyntas* (*argiades*) and its var. *polysperchon*. *Argiades* is therefore the type.

1818 *circa*. Lampides, Hübner.—Heterotypical. Used in 1869 by Newman for *boeticus*. Confirmed by Kirby in 1896.

1818 *circa*. CHRYSOPHANUS, Hübner.—Heterotypical. Restricted in 1841 by Westwood to *phlaeas*, *hippothoë* and *virgaureae*. Type fixed in 1875 by Scudder as *hippothoë*.

1818 *circa*. SCOLITANTIDES, Hübner.—Created for *battus*, Hb. (*orion*, Pall.), and *hylas*, Hb. (*baton*, Bergs.). Type fixed in 1896 by Kirby as *orion*.

1818 *circa*. THESTOR, Hübner.—Erected for *protumnus* and *ballus*. Restricted by Lederer in 1857 to *ballus*, excluding *protumnus*; *ballus* therefore becomes type. Used also thus in 1861 by Staudinger.

1818 *circa*. LYCUS, Hübner.—Type fixed in 1835 by Stephens as *rubi*, but the name preoccupied from 1787 (in Coleoptera).

1818 *circa*. BITHYS, Hübner.—Heterotypical. Restricted in 1835 by Stephens to *quercûs*, and confirmed by him in 1850; this is, therefore, the type.

1818 *circa*. STRYMON, Hübner.—Heterotypical. Restricted in 1835 by Stephens to *pruni*, *betulae*, *w-album* and *spini*. Scudder's action, therefore, in 1872, in fixing *titus* as type is *ultra vires*. We would suggest *pruni* as type.

1820. CALLOPHRYS, Billberg.—Type fixed in 1875 as *rubi* by Scudder.

1827. NEMEOBIUS, Stephens.—Created for *lucina*, sole species and therefore type. Falls as a synonym of *Hamearis*.

1828. PITHECOPS, Horsfield.—Heterotypical. Horsfield described *hylax* at length, citing also *alsus*, *lysimon*, *pheretes* and *damon*. We consider *hylax* Horsfield's type.

1839. TOMARES, Rambur.—Created for *ballus*; sole species and therefore type. Falls as a synonym of *Thestor*, Hb.

1858. LÆOSOPIS, Rambur.—Created for *roboris*; sole species and therefore type.

1881. ZIZERA, Moore.—Type fixed by Moore as *minima*, therefore falls as a synonym of *Cupido*.

1906. RUMICIA, Tutt.—Created for *phlaeas*, which is therefore the type.

1906. CELASTRINA, Tutt.—Created for *argiolus*, which is therefore the type.

1906. LANGIA, Tutt.—Created for *telicanus*, which is therefore the type.

1906. LOWEIA, Tutt.—Created for *dorilis* and *alciphron*, the form being the type.

## Family: RURALIDÆ.

This family comprises some of the most beautiful and interesting of the Rhopalocera. The glorious and vivid tints of the "blues" and "coppers" on the upperside, the exquisite delicacy of their underside markings, the conspicuous sexual diversity in colour and markings, and the frequent sprightliness of their habits, mark them off as certain to attract the earnest attention of all lepidopterists. The Palæarctic members of the family subdivide very naturally into three sections, the *Ruralinae* (*Theclinae*), or hairstreaks, the *Lycaeninae*, or blues, and the *Chrysophaninae*, or coppers. The family is much more developed in the subtropical than in the temperate regions of the earth, the Lycænids being particularly numerous in the Old World, the Ruralids (Theclids) in the New World, although they extend in both hemispheres in such a manner as to give more than a fair sprinkling to the species of the temperate fauna, or, as Scudder says: "They are far more abundant in the tropics than in the temperate zones, but even in the latter, especially in Europe, they form a large proportion of the species." A very few species appear to be common to both hemispheres, but many genera present very closely allied species, especially in the north temperate zone. There are many general characters in which this family shows alliance with the Urbicolids, in spite of the great differences that exist between them. Of these we need only mention—(1) The tendency to flattening of the ovum, so that the vertical axis is less than the horizontal. (2) The presence of lenticles in the larvæ of both groups. (3) The similarity in certain antennal characters.

Of the structural features of the Ruralids to be noticed, the egg is very characteristic. It is generally very opaque, thick-shelled,

echinoid, or tiarate, in shape, usually covered with a most beautiful surface ornamentation, often of a surpassing beauty only equalled in our experience in the eggs of the Limenitids; rarely is the reticulation low, or the egg comparatively smooth; details of the eggs of the various species may be obtained from our extended descriptions.

The larvæ are characterised by their "onisciform" or "woodlouse" appearance. Very rarely, even in their early stages, are they at all inclined to be cylindrical; they are generally covered with minute microscopic hairs, or hair-points; their prolegs are usually very short, and their gliding movements have often been compared with those of slugs. The large prothorax and small head (exactly opposite to the condition found in the Urbicolids) are remarkably suited to the peculiar habit that the larvæ have of withdrawing the head within the prothoracic segment; the abdomimal segments are peculiar, and the terminal segments have often the appearance of being quite united, or coalesced. The presence of an eversible vesicle on the dorsum of the 7th abdominal segment, from which a sweet fluid, beloved of ants, is secreted, and the further development of a pair of lateral evaginable processes on the 8th abdominal segment, whose function is unknown, are also to be noted.

The pupa is short, thick, ovate in outline, and rounded; the head and anal segments are turned ventrally, the waist developed, but still of considerable thickness; the surface usually covered with fine hairs; generally attached Papilionid-fashion by a cremastral attachment and body-girth; sometimes, however, unattached, or quite free.

Of the imaginal structures the front pair of legs are atrophied in the ♂, but not in the ♀. Scudder notes that this atrophy consists of a complete or partial loss of the normal terminal appendages. In the Ruralids (Theclids) the tarsi are armed at the tip with a pair of spines, which are only slightly larger and more curved than the others, while the inferior surface of the tarsi is furnished with an irregular mass of spines on either side; in the Lycænids, the terminal armature consists of a single, median, tapering claw, scarcely curved, while beneath, the tarsi are supplied with only two or three rows of spines; in the Chrysophanids a single median spine, differing from the others only in size, occupies the tip, while the undersurface of the tarsi is armed with frequent spines usually clustered upon the sides. Of the antennæ, Jordan says (*Nov. Zool.*, v., pp. 411-12) that the Ruralids have preserved a most ancestral form of arrangement of bristles, and adds that (1) the dorsal side is never without scaling, (2) the fine sense-hairs distally are of very low type, (3) the configuration of the ventral surface is ancestral, but sometimes shows faint indication of Erycinid specialisation, (4) sense-bristles are ancestral on distal joints dorsally and ventrally; sometimes specialised as in Erycinids, seldom as in Hesperiids. The Lycænids stand in relationship with Erycinids, probably also with Urbicolids. With regard to the femoral spine described by Horsfield and Westwood as being present on the middle pair of legs, Scudder says "these are nothing more than an arrangement of the scales, or hairs, for the greater mobility of the legs; the denuded femur and tibia show here no process and no depression whatever." Scudder gives the following diagnosis of the family (*Butts. of New England*, ii., pp. 791 *et seq.*) :—

IMAGO: Head small; front flat or a little tumid, usually protuberant below; vertex separated from the occiput by a continuous sulcation; antennæ consisting of from 28 to 34 joints, very slender, thread-like, scaled, from as long as to half as long again as the abdomen, the club rather distinct, long and equal, occupying from one-third to one-sixth of the whole antenna; palpi slender, of moderate length, compressed, half the palpus surpassing the face. Thorax variable, though not greatly, in stoutness, never very stout, sometimes a little compressed; posterior angle of mesoscutellum well marked, acute. Forewings with internal nervure obscure or obsolete; hindwings with no precostal nervure, the costal extending nearly, or quite, to the tip of the costal margin, the basal half of the inner margin channelled to receive the abdomen. Forelegs of ♂ with naked tibial spurs and sometimes a few spines, the tarsi five-jointed and armed like the forelegs of the ♀, excepting that paronychia and pulvillus are wanting, and, in the place of the claws, either slightly modified apical spines, or the same connate, forming a triangular, slightly arcuate, median hook. Middle tibiæ as short as, or shorter than, the hind pair. ♂ GENITAL ORGANS: Upper organ consisting mainly of extensive lateral alations, developing differently in the various groups, narrowly united at the base medially, but always bearing on either side beneath a long and slender, strongly bent or curved, tapering, pointed arm, the extremity of which is directed either backward or partially upward; intromittent organ excessively long, slender, expanding at the tip; clasps slender, generally tapering and much longer than broad, usually pointed at the tip, and but slightly armed or wholly unarmed.

EGG: Echinoid or demiechinoid in shape, much broader than high, the centre of the summit usually depressed considerably; surface pitted, generally conspicuously, with deep or shallow cells, usually bounded by rather heavy walls; micropyle often seated at the bottom of a deep and narrow depression.

LARVA (newly hatched): Generally agreeing in the form of the body with the mature larva, but with the contrasts of the summits and sides a little more pronounced; sometimes almost or quite cylindrical; armed at the angle formed by the flattened dorsal region and the sides, with a series of papillæ emitting hairs, some at least of which are exceedingly long, curving backwards and minutely spiculiferous; also, at the fold separating the sides from the expanded venter, with a series of very numerous papillæ, bearing long, straight, laterally extending hairs; on the sides one or more longitudinal rows of papillæ.

LARVA (mature): Head small, well rounded, narrower than the narrowest part of the body, smooth, more or less retractile within the prothorax. Body comparatively short and broad, onisciform, the under surface flattened, the upper transversely arched, the dorsal field flattened and the sides often more or less compressed; broadly rounded in front, the 1st thoracic segment very large and tumid, more sharply rounded behind, the last abdominal segment alone being about as long as broad; otherwise nearly equal or tapering slightly posteriorly; armed with no conspicuous appendages; spiracle of the 8th abdominal segment almost invariably above the line which the others follow. Legs and prolegs very short and small.

PUPA: Body short, thick, plump, rounded, with rare exceptions (*e.g.*, *Feniseca*) entirely without angulations, excepting a very slight, blunt, elevation at the base of the wings; broadest at about the 3rd abdominal segment, tapering from there in either direction, more rapidly behind than in front. Head entirely on the under surface, the division between thorax and abdomen only slightly marked. Both extremities very bluntly rounded; the whole lower surface straight, often much flattened. Head not at all prominent, the ocellar prominences wanting. The prothorax largely developed. Wings scarcely raised above the general surface, their edges not at all thickened. Mesothorax stout, not greatly elevated, but broadly arched longitudinally. Metathorax large at the sides, narrow in the middle. Abdomen large and stout, at first broadly arched longitudinally, in the posterior half the slope falling very rapidly to the tip, which is on a level with the under surface. Cremaster appressed to the body (in *Feniseca* only forming an independent prominence), broad, the hooklets (except in *Feniseca*) either wanting or placed in a curving row at the sides and posteriorly, very slender, generally rather short, the stem equal, the apical portion suddenly expanding into a transverse slightly convex lamella bent strongly over, the apex transverse. Attached in almost any position by a girt across one of the basal abdominal segments, and

feebly secured behind by seizing the silken threads with the joints of the posterior segments or the few hooklets.

The family is to be subdivided into at least three very characteristic subdivisions, of the inter-relation of which we have, however, at present, no very clear and distinct knowledge. These are the "hair-streaks," the "blues," and the "coppers," which Scudder has treated as tribes of equal value, giving somewhat elaborate synopses in support of this view. These are based (*Butts. of New England*, ii., pp. 797-8) on the different stages, as follows:

Egg:—Flattened tiarate, almost as much depressed above as truncate below; central depression of summit (including, but not limited to, the micropylic pit) one-fourth or more the diameter of the egg, or the whole summit flat; angles of cells marked by prominences rising conspicuously above the general surface.

Generally larger, the central depression (as above) covering one-fourth to one-half the width of the egg, the micropylic pit generally deep .. .. .. .. .. .. .. Theclidi.

Generally smaller, the central depression generally covering from one-half to three-fourths the width of the egg, the micropylic pit comparatively shallow .. .. .. .. .. Lycænidi.

Domed, tiarate, much less depressed above than truncate below. the central depression of the summit less than one-eighth the diameter of the egg, the whole summit otherwise distinctly convex; angles of cells without, or with, only slight prominences .. .. .. .. .. .. .. Chrysophanidi.

Larva (newly-hatched):—Head noticeably narrower than the body; prothorax scarcely larger than the others; last three abdominal segments more or less fused and furnished above in the centre with a large, sunken, subcircular area, in front of which, on either side, is a curving series of several smooth naked papillæ Theclidi.

Head nearly, or quite, as broad as body; prothorax distinctly larger than the others; 7th abdominal segment wholly free, and with no papillæ besides those of the longitudinal series.

Prothorax not greatly larger than the others; last two abdominal segments fused; uppermost range of bristles latero-dorsal, these generally not much longer than width of body .. .. .. Lycænidi.

Prothorax generally very much larger than the others; the 8th abdominal segment wholly free; uppermost range of bristles subdorsal, generally almost, or quite, half as long as body Chrysophanidi.

Larva (mature):—Head excessively small, not one-fourth, sometimes not one-sixth, the width of the body; dorsal shield of prothorax wanting, or else covered with hairs as thickly as the neighbouring parts .. .. Lycænidi.

Head moderately small, generally at least one-third, sometimes one-half, the width of the body; dorsal shield of prothorax distinct and naked, or clothed much less abundantly with hairs than the neighbouring parts.

Highest portion of body-segments lying behind the middle, generally next the posterior edge, or, if on the middle, with the posterior slope more abrupt than the anterior; head generally smaller than in *Chrysophanidi*, capable of being extended two or three times its length beyond the body .. .. .. .. .. .. .. Theclidi.

Highest portion of body-segments at the middle, or in front of the middle of the segments, the anterior slope the more abrupt; the head generally larger than in *Theclidi*, not capable of special extension Chrysophanidi.

Pupa:—Dermal appendages formed of cylindrical spiculiferous and pointed, or apically stellate, hairs.

Dermal appendages tapering only at the tip, the spicules inclined at a slight angle. Whole body shorter and stouter than in *Lycaenidi*, the abdomen especially being very short and full, rarely more than half as long again as broad .. .. .. .. .. Theclidi.

Dermal appendages tapering throughout, or apically stellate, the spicules, when present, inclined at a right angle. Whole body longer and slenderer than in *Theclidi*, the abdomen, especially, being more elongate, generally nearly twice as long as broad .. .. Lycænidi.

Dermal appendages short, distinctly fungiform, without spicules Chrysophanidi.

Imago:—Third superior subcostal nervule of forewings simple; under surface of hindwings generally with continuous, or subcontinuous, markings Theclidi.

Third superior subcostal nervule of forewings forked; under surface of hindwings generally with discontinuous, though ranged, markings.

Stouter bodied, with colours of upper surface usually more or less violet; spines on under side of tarsi comparatively few, and ranged in pretty regular series; clasps tapering, apically pointed LYCÆNIDI.

Slenderer bodied, with colours of upper surface more or less coppery; spines on underside of tarsi numerous, and clustered irregularly at the sides; clasps subequal, apically rounded .. .. CHRYSOPHANIDI.

It may be advisable here to give Meyrick's grouping of the family, to show how the selection of a single relatively unimportant character for a subdivision on broad lines, may lead one into the most conspicuous error. A comparison of the characters used by Scudder and Meyrick respectively, and their results proves instructive. Meyrick classifies (*Handbook*, etc., pp. 342 *et seq.*) the group thus:

LYCÆNIDÆ: Anterior legs developed, but tarsi of ♂ more or less abbreviated, or with one or both claws absent; posterior tibiæ without middle-spurs. Forewings: 7 absent, 8 and 9 stalked or coincident. Hindwings without præcostal spur. Ovum flattened spherical or subcylindrical, reticulated and sometimes ribbed, seldom smooth (*L. arion*). Larva stout, with few hairs. Pupa attached by tail and a central belt of silk, or sometimes unattached or subterranean.

1. Forewings with 6 out of 9 .. .. .. 1. THECLA.
   Forwings with 6 separate .. .. .. 2
2. Eyes glabrous .. .. .. .. .. 2. CHRYSOPHANUS.
   Eyes hairy .. .. .. .. .. 3. LYCÆNA.

1. THECLA, F.—Eyes hairy. Club of antennæ elongate. Forewings: 6 out of 9, 8 out of 9 or absent—*T. rubi*, *T. pruni*, *T. w-album*, *T. betulae*, *T. quercûs*

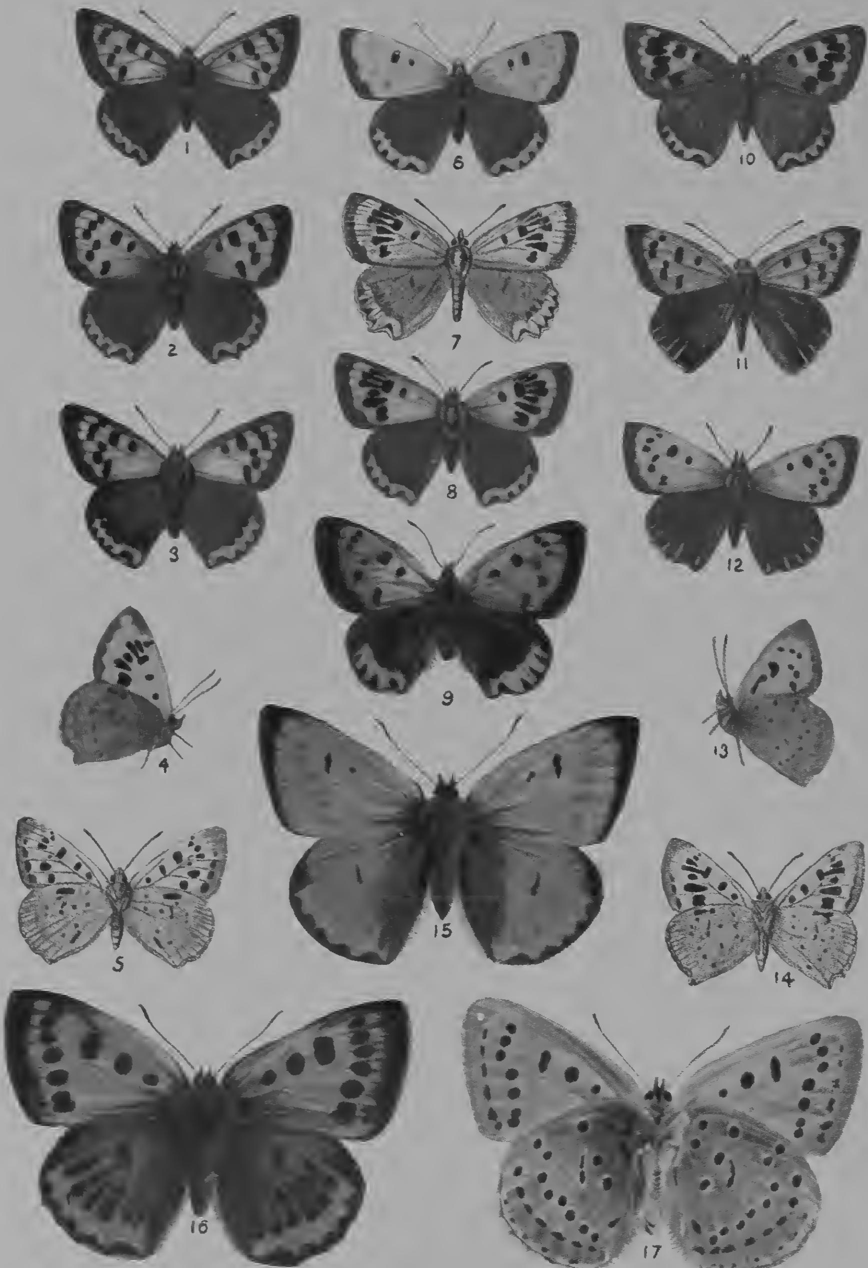
2. CHRYSOPHANUS, Hb.—Eyes glabrous. Club of antennæ elongate. Forewings: 6 separate, 8 and 9 stalked—*C. argiades*, *C. minimus*, *C. semiargus*, *C. astrarche*, *C. phlaeas*, *C. dispar*.

3. LYCÆNA, F.—Eyes hairy. Club of antennæ elongate. Forewings: 6 separate, 8 and 9 stalked—*L. baetica*, *L. argiolus*, *L. corydon*, *L. bellargus*, *L. aegon*, *L. icarus*, *L. arion*.

Such a grouping as this needs no condemnation. On the strength of the eyes being "glabrous" or "hairy" one finds *Cupido minimus*, *Chrysophanus dispar*, *Aricia astrarche*, etc., in one genus, and *Lampides boetica*, *Celastrina argiolus*, *Lycaena arion*, *Agriades corydon*, etc., in another.

Our own grouping (*British Butterflies*, pp. 146 *et. seq.*) in 1896, reads as follows:

Division: LYCÆNIDA.
  Family: LYCÆNIDÆ.
    Subfamily: LYCÆNINÆ.
      Tribe: CHRYSOPHANIDI.
        Genus: CHRYSOPHANUS—*C. dispar*, *C. phlaeas*.
      Tribe: LYCÆNIDI.
        Genus: LYCÆNA—*L. arion*.
        Genus: CUPIDO—*C. minima*.
        Genus: NOMIADES—*N. semiargus*.
        Genus: POLYOMMATUS—*P. corydon*, *P. bellargus*, *P. icarus*, *P. astrarche*.
        Genus: PLEBEIUS—*P. aegon*.
        Genus: EVERES—*E. argiades*.
        Genus: CYANIRIS—*C. argiolus*.
      Tribe: THECLIDI.
        Genus: CALLOPHRYS—*C. rubi*.
        Genus: ZEPHYRUS—*Z. quercûs*, *Z. betulae*.
        Genus: THECLA—*T. w-album*, *T. pruni*.
  Family: LEMONIIDÆ.
    Subfamily: LEMONIINÆ.
      TRIBE: NEMEOBIIDI.
        Genus: NEMEOBIUS—*N. lucina*.




British Chrysophanids.

## PLATE XIII.

*(To be bound facing Plate XIII.)*

CHRYSOPHANID IMAGINES.

1. RUMICIA PHLÆAS ♂.
2. ,, ,, ♀.
3. ,, ,, ab. ALBA.
4. ,, ,, ab. INFRA-EXTENSA.
5. ,, ,, ab. INFRA-RADIATA.
6. ,, ,, ab. BIPUNCTATA.
7. ,, ,, ab. EXTENSA-CONJUNCTA.
8. ,, ,, ,,
9. ,, ,, ,,
10. RUMICIA PHLÆAS ab. KOCHI.
11. ,, ,, ab. RADIATA ♂.
12. ,, ,, ,, ♀.
13. ,, ,, ab. DISCO-JUNCTA.
14. ,, ,, ab. INFRA-RADIATA.
15. CHRYSOPHANUS DISPAR ♂.
16. ,, ,, ♀.
17. ,, ,, (underside).

In 1897, Grote accepted our classification with some slight modifications (*Schmett. von Hildesheim*, p. 41), and grouped the superfamily as follows :

Family : Lycænidæ.
  Subfamily : Theclinæ.
    Tribe : Theclini.
      Genus : Callophrys—*C. rubi.*
      Genus : Thecla—*T. spini, T. ilicis, T. pruni, T. w-album.*
    Tribe : Zephyrini.
      Genus : Aurotis—*A. quercûs.*
      Genus : Zephyrus—*Z. betulae.*
  Subfamily : Lycæninæ.
    Tribe : Lycænini.
      Genus : Lycæides—*L. aegon.*
      Genus : Rusticus—*R. argus.*
      Genus : Nomiades—*N. semiargus.*
      Genus : Polyommatus—*P. corydon, P. icarus, P. bellargus.*
      Genus : Lycæna—*L. arion.*
      Genus : Cupido—*C. minima.*
      Genus : Cyaniris—*C. argiolus.*
    Tribe : Chrysophanini.
      Genus : Heodes—*H. phlaeas.*
      Genus : Chrysophanus—*C. hippothoë, C. dorilis.*
Family : Nemeobiidæ.
  Subfamily : Nemeobiinæ.
      Genus : Nemeobius—*N. lucina.*

Chapman agrees in the main with Scudder's grouping. He suggests (*in litt.*) that the family falls into three very characteristic groups of subfamily value (so far as the Palæarctic species go), which he calls the Lycæninæ, Chrysophaninæ, and Theclinæ, the last-named having its elements more widely distinct than the others. He says that the "coppers" come much nearer to the "blues" than to the "hairstreaks." *Callophrys rubi* and *Thestor ballus* are unquestionable Theclids, the separation between them and the other "hairstreaks" is an arbitrary boundary, that between them and the "coppers" is a broad neutral boundary, whose inhabitants we do not know. *Lampides* (*boeticus*) is distinctly a Lycænid allied to *Everes* (*argiades*), *Celastrina* (*argiolus*), and *Langia* (*telicanus*), none of them very near each other, *Lampides* perhaps furthest from the "blues," as typified by *Agriades* (*corydon*, etc.)., *i.e.*, judged by their genital organs; the "blues" being the more generalised group.

The habits and habitats of the butterflies included in this family are exceedingly varied. The Ruralids (Theclids) appear to prefer wooded districts, their larvæ being largely restricted to trees and bushes for food, but the "coppers" and "blues," whose larvæ mostly feed on low plants, are to be found in almost every conceivable situation—woods, fields, downs, moors, lanes, roadsides, marshes, etc., all have their particular species. So in the highest latitudes and altitudes, certain species of "blues" are to be found, never coming into the lower ranges of latitude, or into the valleys, but keeping to their own altitudes on the edges of glaciers, where the winter is long, and summer short; such are the beautiful *Polyommatus pheretes*, *P. eros*, and many other species.

## Subfamily : Chrysophaninæ.

### Tribe : Chrysophanidi.

This subfamily is the *Chrysophani* of Hübner (*Verz.*, p. 72), the oldest name carrying a genus with it, although the *Rutili* of Schiffer-

müller and the *Cupreae* of Haworth are older, and equally suitable, group names. The species of this tribe comprise some of the most brilliant of our Palæarctic species, their bright refulgent copper colour glistening in the sun, sometimes shot with a most delicate violet hue, sparkling gems bathing in the hot sun of our alpine valleys, or walking round and round, working their hindwings like revolving discs, hustling, fighting, drinking nectar from the flowers, the acme of beauty and self-indulgence. The sexual diversity is usually great, and, whilst in some species, *e.g.*, *Loweia dorilis*, the ♂ is quite black-brown, and the ♀ may be copper; in *Chrysophanus hippothoë* the ♂ is copper tinged with purple, and the ♀ brown-black often with scarcely any copper in it. Some of the species are coppery in both sexes, marked with transverse series of square black spots; others have fine delicate tails (reminding one of the hairstreaks); and, whilst the undersides of some are scarcely separable in their markings from those of the Polyommatids, in others, there are fewer markings than in the hairstreaks. Scudder says: "This group contains the stoutest of the *Lycaeninae*, and is far less numerous in species than the tribes already mentioned. Their heavy markings and the lustrous reddish or fulvous tint of their upper surface, which has won for them the popular name of 'coppers,' distinguish them at a glance from other groups. Their hindwings rarely bear the thread-like tails peculiar to many of the *Lycaeninae*, although, in some exotic genera, the anal angle is sometimes considerably produced. The disposition of the markings of the undersurface closely resembles that in the *Lycaenidi*, to which they are much more nearly allied than to the *Theclidi*. Many of the species frequent moist, boggy places, while others rejoice in the full blaze of the sun in arid pastures or by the roadside. Their flight is quick, usually short, abrupt, and rather infrequent; they seldom wander far; like some of their allies they are often very pugnacious, darting from their resting-places at any passing object."

The Chrysophanid egg is very characteristic, and its peculiarities are well exhibited in our pl. iii., figs. 3, 4, 5, 6 where are exhibited ova of *Rumicia phlaeas* (figs. 3 and 4), *Heodes virgaureae* (fig. 6), and *Chrysophanus hippothoë* var. *gordius* (fig. 5). The large open cells that form so striking a feature of its sculpture, have no real near approach in the eggs of other Ruralids known to us, *e.g.*, the Thestorids, as exemplified by *Thestor ballus* (pl. iv., fig. 1), the Callophryids, as exemplified by *Callophrys rubi* (pl. iv., fig. 2), the Lycænids, as exemplified by the eggs of *Aricia* var. *artaxerxes*, *Polyommatus icarus*, *Agriades bellargus*, *A. corydon* (pl. iv., figs. 3, 4, 5 and 6 respectively), etc. The nearest approach to them appears to be shown by the eggs of *A. corydon* (pl. iv., fig. 6) The eggs are laid singly, but often several on a single plant.

The Chrysophanid larva is essentially Ruralid in structure, *i.e.*, it is of the typical outline, common to "blues" and "hairstreaks," but is, perhaps, rather less markedly raised dorsally. Chapman considers that the larva of *Chrysophanus dispar* is the most markedly limaciform of those examined, differing in this respect widely from *Rumicia phlaeas* and *Heodes virgaureae*, which are very similar to each other. The marginal flanges are noticeably closely applied to the surface on which the larva crawls. Besides the usual tubercular hairs, minute skin-hairs are very abundant but not visible without a lens; their trumpet-shaped tops are very

## Plate III

*(To be bound facing Plate III)*

Eggs of Urbicolids and Chrysophanids.

Fig. 1.—Nisoniades tages.
Fig. 2.—Hesperia malvæ.
Fig. 3.—Rumicia phlæas.
Fig. 4.—Rumicia phlæas.
Fig. 5.—Loweia alciphron var. gordius.
Fig. 6.—Heodes virgaureæ.

All $\times 20$ diameters.

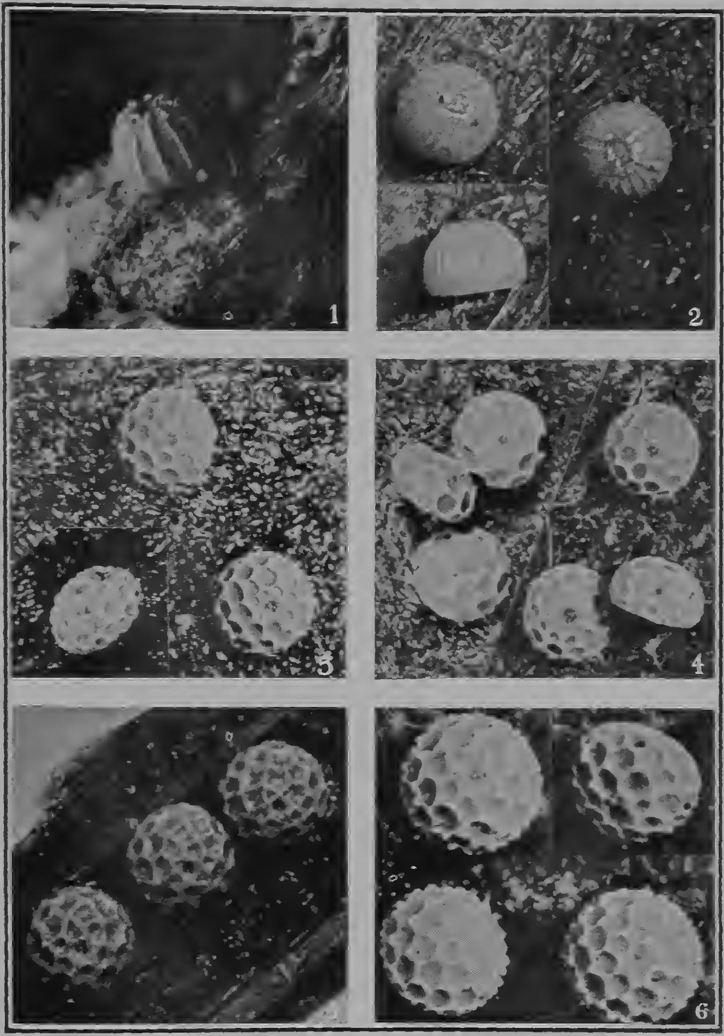



*Photo. A. E. Tonge.*

EGGS OF URBICOLIDS AND CHRYSOPHANIDS.

characteristic. These have the appearance of white points scattered over the surface of the almost transparent skin; full descriptions of the lenticles and other larval structures will be given in our detailed descriptions of the larvæ.

The Chrysophanid pupa is of characteristic Ruralid form, and will be described in detail later. Taking the pupa of *Rumicia phlaeas* as typical of the Chrysophanids, and that of *Ruralis betulae* as typical of the Ruralids (Theclids), one finds that the former differs from the latter in its more uniform width, in the better developed ventral abdominal segments, in the prolongation of the antennæ beyond the wings, the absence of puckering and folding on the extreme edge of the outer margin of wing, also in the better developed cremaster, and the more marked wing neuration. They are similar in having short maxillæ, in the ventral position of the glazed eye, in the distance of the antennæ from each other when they leave the ventral surface, in the conspicuous first spiracle, in the traces or scars of supraspiracular tubercles, and in the base of the first pair of legs covering the base of second pair. Chapman has pointed out (*Ent. Rec.*, xvii., pp. 172 *et seq.*) the peculiar structures of the pupal skin of *Rumicia phlaeas*, illustrating it by figures, which we reproduce on our pl. x., figs. 1-2. He compares the skin-structure with that of *Thestor ballus*, while he has described and figured (*Ent. Rec.*, xvii., p. 145, pl. v., figs. 1 and 2). He observes that, on the dorsum of a pupa of *R. phlaeas*, there is a number of points joined together by fine ridges; the points are of two kinds, very distinct in their nature and structure, and yet, perhaps, identical, in that certain intermediates exist. Those that are most definitely pointed are very much smaller than those of *T. ballus*, and, although the structure of some is not very evident, in most it seems to consist of a raised thick ring with a central knob, that is hardly part of the ring, but set within it. The ring is very smooth in outline, both inside and out, and the inner little knob is separated from it by a paler ring that looks very similar to the membrane, or articulation of a hair; the little knob seems to be of simple structure, and without any of the stellate form of those in *T. ballus*. The other form of "points" are veritable hairs, *i.e.*, they have definite circular bases, just like those of ordinary hairs, and, centrally, is articulated a movable structure, that can only be morphologically a hair. These hairs are, however, of very elaborate structure; they are hollow, and expand at the tops, so as to be trumpet-shaped, the bell of the trumpet being large, wide, and expanded, or they may be likened in form to the well-known fungus, the chantarelle. The margins of the bell, however, are not smooth, but cut up into quite a *chevaux de frise* of spikelets, and, in some specimens, can be made out into an inner circlet of similar needlepoints, a little way within the bell. One or two specimens suggested that these inner spikes were on a separate membrane, that, when the specimen was fresh, formed a dome-shaped cover to the open mouth of the trumpet. One suspects that the first class of points are really hairs like the second, in an abortive or undeveloped state, and, on comparing, critically, these structures with those of *T. ballus*, the stars on that pupa would seem to be similar, morphologically, to the hairs of *R. phlaeas*, but reduced, like those of the first kind of points on *R. phlaeas*, to a mere base, but still preserving, in their stellate form, the fringed and spiculate idea involved in the trumpet of *R. phlaeas*.

Continuing his studies, Chapman deals with the sculpturing of the pupal skin of *C. dispar* (illustrating his further notes by the figures which we reproduce in our pl. xi., fig. 2). The pupal surface is, as in that of *R. phlaeas*, marked out in small polygonal areas by raised ribs, which have, at their junctions, rounded tubercles, of which the darker interior shows some indication of radial division into sections; the arrangement being, probably, indentical with that of *T. ballus* (*Ent. Rec.*, xvii., pl., v., fig. 1), in which the cells, however, are much smaller and the ribs and tubercles larger, the latter with more obvious detailed structure. One observes, in *C. dispar* (pl. xi., fig. 2), that, of the ribs that usually join the tubercles, some sometimes fail to do so, and lose themselves by spreading out on the flat areas, often fairly close together, but with the aspect of preferring to take a slightly different direction, and finish rather than meet their neighbours. (This phase is well-illustrated in *T. ballus.*) In some areas all the tubercles are bunched up to their neighbours, and there are no loose ends; in others, the ribs merely continue the hexagonal structure of the tubercles and alternate with neighbouring ones, instead of meeting them. Although at first suggesting that these tubercles represented skin-hairs, the idea seems doubtful, since they never by any chance carry hairs. The few very small hairs that occur on the pupa of *T. ballus* always occupy the clear interspaces, and are, therefore, the representatives of the trumpet-hairs of the Chrysophanids. It is especially to be observed that, in *R. phlaeas* and *C. dispar*, the trumpet-hairs arise from bases in the interspaces, and never from the ribs or their associated tubercles. The trumpet-hairs of *Heodes virgaureae*, described and figured by Chapman (*Ent. Rec.*, xviii., p. 89, pl. iv., figs. 1 and 2), are exhibited in our pl. xi., fig. 1, and might well be called "umbrella" hairs. They are most numerous near the spiracles, and towards the latter segments, but also exist over most of the spiracular region. Each has a long narrow pedicel and a flat umbrella-like top, the latter appearing to include a lower surface spreading out from the stalk, and a separate dome-like top, the latter studded with raised points, but this is somewhat doubtful, and the top may be really centrally depressed, and be, in fact, merely the upperside of what, on the other view of the structure, has been called the lower surface. They appear to be 0·06mm. in height, and of nearly the same diameter. The fig. 2 shows the form and distribution of the surface spicules, also that the structure is really of "trumpet" form, and that there is no top apart from the expansion of the side of the hair. It also indicates the want of relation of the origin of the hairs to the fine network of ribbing, and the knobs at their points of intersection, noted in the other species. If our pl. xii., figs. 1 and 2, be compared with pl. x., figs. 1 and 2, a very definite difference will be seen between the pupal sculpture and hairs, otherwise so much alike, of *Rumicia phlaeas* and *Chrysophanus dispar*. In the former, there appear to be no hairs, except the trumpet-hairs, whilst in the latter there are long hairs (0·08mm.-0·17mm.) of more ordinary type. These occur, however, only in the circumspiracular region, including the prothorax. Each hair is a little swollen on its last third, and from the surface of this portion arises a number of fine spiculæ, generally standing out at right angles to the axis of the hair, and producing a very different appearance from the spiculated hair so often met with.

Chapman further observes (pl. xii., fig. 1) that, in *Chrysophanus dispar*, the great mass of the circles unprovided with hairs are no doubt lenticles; some, he says, may be hair-bases, where the hairs have been lost, and those that are not obscured (by air), are seen to possess a membrane or diaphragm of minutely dotted structure, like that usually met with in lenticles. The spiracle is of elaborate structure, and may be described as an oval tube, nearly as long as it is wide, with the opening it presents diminished to a central slit by membranous outgrowths in the sides, nearly meeting in the middle; each of these seems to be a pillar of transparent material, expanded at top into a flat plate. This differs much, if not in essential structure, from that of *Rumicia phlaeas*, in which each spiracle has an outer projecting mass, of a *chevaux de frise* character, looking as though the pillars (in *C. dispar*) did not end within the spiracle, but, bending, emerged from the middle of the spiracle, and then turning outwards in rounded batons closely-set together, of a length rather greater than half the width of the spiracle, formed a sort of outer basket-shaped structure, but of such transparent materials that it is difficult to decide whether it does consist of a number of separate batons, or whether the lines are only grooves on a continuous structure. The pupæ of *C. dispar* and of *R. phlaeas*, he says, present certain spiculated areas that very strongly suggest the spiculæ on Nepticulid pupæ and those of other lower micro-lepidoptera, which are the forerunners and primary forms of the rows of spines so well-developed on the pupæ of Tortricids and various other of the higher micro-lepidoptera. They agree with these micro-spiculæ in their distribution and in their attitude, *i.e.*, directed backwards (not dorsally but terminally). They are very small, but are more or less similarly arranged in rows. On the forward abdominal segments they are dorsal only. On the 7th and 8th they are also lateral, and on the 9th and 10th they occur ventrally and over wider areas. In both species they occur as an anterior band along the anterior borders of the segments, and a posterior close to the hind margin. The anterior row occurs in *R. phlaeas* on all segments 2-9, the posterior on 1, 3, 4, 5, 7 and 8. The posterior row on 2nd abdominal segment is quite forward of the posterior margin, without being quite in the middle of the segment. This is also the case in *C. dispar*, in which the anterior row exists on 2, 6, 7, 8 and 9, and the posterior on 3, 4, 5, 6, 7 and 8.

Plate xii., fig. 2, represents a portion of the cremaster of *C. dispar*. The cremaster consists of a very large number of hairs about 0·14mm. long, with a double anchor-like hook, or pair of hooks, at the free end. Just above these, on the right, is seen an area of skin-points, which are very similar to, and continuous in distribution with, those already referred to as forming the micro-like rows. These rows of spicules have no apparent relation with any larval structures; the full-grown larva of *R. phlaeas* has spiculated hairs, but no skin-points, the skin-surface being divided into a mesh of hexagonal cells by a fine network of lines. Chapman says that it seems difficult to avoid looking for some relationship with some micro-ancestor to account for them, and yet it is almost more difficult to explain their survival, since they must have been useless for their original functions for many ages. It is, however, no easier to suggest any other origin for them, or to imagine what useful functions

they can now perform. To return to the cremastral area and its hooks, it is impossible to satisfy oneself as to the limits of the 9th and 10th abdominal segments. On the ventral line, the 7th segment is clear enough, but the 8th is so contracted and fused with the 9th, that even its limits are doubtful. Except on the ventral line, the posterior margin of the 8th is definite enough. Within the circle it encloses, to take the specimen of *C. dispar* before us, and specimens of *R. phlaeas* agree with it, we find first in the dorsal half, an area much like the rest of the pupa, with buttons, ribs, and trumpet-hairs, but with a small central area smooth, except for some lines radiating from its centre. This has all the appearances of a scar, not unlike that of the horn in Sphingids, but whether of some injury or normal might be doubtful, were it not that other specimens present a very similar appearance. Turning to the ventral half of the area, we find it more delicate and transparent, and divided across the middle by a suture, which does not, however, reach either side. The whole of the area is armed with the cremastral hooks, except a portion in the middle line, slightly behind the suture noted, but chiefly between it and the front of the segment. In the middle of this clear area are two projecting points side by side, and, running forwards from between them, two fine ridges with a groove between, ending in front by widening out into a rounded lappet, with a surface of extremely fine spiculations. This appears to be at a different level from the portion of segment that seems to overlap it from either side and carries the hooks, and one might suppose this to be 9th and the hooks on the 10th, but those immediately behind the surface are continuous, without intervening suture.

Scudder gives the following diagnosis of the group (*Butts. of New England*, ii., p. 970) :—

Imago : Colour coppery. Club of antenna equal for most of its extent, rather long, and very slender, being two or three times as broad as the stalk, and from four to six times longer than broad. Patagia very long and slender, usually three or four times longer than broad; subcostal nervure of forewings with three superior branches, the outermost forked, the nervure itself running in a direct, or nearly direct, course, to just below the tip of the wing; tarsi armed beneath with frequent spines, usually clustered upon the sides; fore tarsi of the ♂ armed at tip with a single median spine, differing from the other spines only in size, and considerably curved. Upper organ of ♂ appendages formed of a deeply cleft plate, whose lateral halves have the appearance of a tapering appendage, and bear at their extreme base slender, elbowed laminæ, directed backward; clasps subequal, and at tip bluntly rounded : intromittent organ acicular, not apically flaring.

Egg : Tiarate, but domed, truncate beneath, but not above, the sunken portion of the upper surface, together with the micropylic pit, including less than one-eighth of the diameter of the egg; the pit itself generally, but not always, moderately deep; surface either simply and finely reticulate, with a scarcely raised tracery, or pitted with polygonal cells, the angles of which do not rise conspicuously above the general surface.

Larva (newly-hatched) : Head as broad as the body. Innermost dorsal bristles arranged partly in a subdorsal series, one long and one short bristle to a segment in each row; infrastigmatal series with three bristles to a segment.

Larva (adult) : Body scarcely narrower in proportion to its length than in *Lycaenidi*, but slightly broader than in *Theclidi;* segments arched somewhat; body clothed uniformly with very short hairs, or with longer hairs arranged in transverse series, sometimes springing from elevated bosses.

Pupa : Body very variable in form (if *Feniseca* be included), but either not forming a single uniformly contoured mass (*Feniseca*), or else a single, long, oval mass, slenderer, and relatively lower, than in the *Theclidi*, and generally more elongated than in the *Lycaenidi ;* dermal appendages fungiform.

The variation of the Chrysophanid imagines is most interesting, particularly that phase in which the ♂ s take on a lovely purple gloss, as in *Loweia alciphron* and *Chrysophanus hippothoë*. But another form of variation in the Chrysophanids has attracted still greater attention. It is what may be termed the suffusion of the ground-colour of the wings, and is well-illustrated in the southern forms of *Rumicia phlaeas*. In central Europe the ♂ s and ♀ s of this species are of a rich golden colour, in all the broods, with a tendency for the ♂ s to become suffused in occasional examples of the summer brood; in the north, the ground colour of both sexes is paler and brighter, with no tendency to suffusion, whilst, in the south of Europe, the ♂ s are mostly suffused in the summer broods, some of them being practically black. In central Europe again, the ♂ s of *Chrysophanus hippothoë* are of a rich golden-copper; in the subalpine regions the ♂ s are tinged with purple, and the ♀ s are brown, with hardly a trace of the copper ground-colour; in Scandinavia the ♀ s may be (often are) of almost as rich a copper tint as the ♂ s. In *Loweia dorilis*, on the other hand, in central Europe, both ♂ s and ♀ s are almost uniformly black-brown, with hardly a sign of copper tint; in the southern parts of Europe, with little or no change in the ♂ s, the ♀ s are sometimes of a brilliant copper, *i.e.*, exactly the converse of *C. hippothoë* and *R. phlaeas*, which get darker with increased temperature. Still more puzzling is *Loweia alciphron*, which, in the hot valleys of south-eastern Europe, produces ♂ s so suffused with violet, and ♀ s so suffused with brown, that the ground-colour and markings entirely disappear, in both sexes, on the upperside, although, in the hot valleys of south-western Europe, they become gloriously brilliant golden-copper, with strongly-marked rows of black spots in both sexes, and form the var. *gordius*, the ♀ of which even surpasses that of *C. dispar* in brilliancy, whilst in the hot valleys of western Italy the race maintains its *gordius* brilliancy of ground-colour, but the basal areas of the hindwings become black, in some senses, forming an intermediate stage between the south-eastern and south-western forms, although possibly an entirely separate specialised development of the var. *gordius*.

The sexual dimorphism of the Chrysophanids is practically as marked as in the "blues," but there appears to be an entire absence of specialised androconia. The sexual differences appear to consist of —(1) The difference in the coloration and markings of the wings. (2) The difference in their shape and contour. As a rule, the ♂ s have unicolorous golden wings, with black margin; the ♀ s have golden wings, with transverse rows of black spots, in some species, however, becoming entirely black-brown, with the exception of the marginal band, in a few, indeed, becoming wholly black-brown, the copper or golden colour being quite obsolete. In *Heodes virgaureae* and *H. ottomanus*, the golden ♂ rarely has a discoidal lunule, and the ♀ is usually paler in tint, with a transverse row of dots, discoidal spot, a browner-black margin, etc. In *Chrysophanus thersamon*, *C. dispar*, and *C. hippothoë*, the ♂ has a discoidal lunule, the hindwings tend to be shaded, and the markings of the underside make a good attempt to show through on the upperside of the wing; the ♂, too, tends to get a purple gloss at higher elevations. In *Loweia alciphron*, *L. dorilis*, and *L. subalpina*, the ♂ is, in all the typical forms, suffused entirely with purple and blackish-brown, whilst the ♀ is more usually tinged with the characteristic copper of

the group. It appears that *amphidamas* forms a separate group in its sexual dimorphism; the ♂, a typical "copper" butterfly, suffused with violet; the ♀ brown, with a marginal band of spots, reminding one of *Aricia astrarche*. *Rumicia phlaeas* has the sexes marked alike, but shows very characteristic difference in the outline and general form of the wings. One small group, comprising *thetis* and *ochimus*, presents the sexual differences noted in *Chrysophanus*, but, in addition, under certain conditions, these species have delicately tailed ♀ s, which appear to be confined to certain broods, and not to be found in others, the tails not of the character of those of *Heodes ottomanus*, *Rumicia phlaeas* var. *eleus*, etc., but long slender extensions similar to those of *Strymon* (*Thecla*) *w-album*, etc.

Scudder says "the insects of the group are peculiar to the temperate regions; south of the tropics a single species occurs in South America, two or three are found in New Zealand, and large numbers in Africa, though probably not appertaining to genera represented in northern latitudes. The mass of the species, however, is found in the northern hemisphere, and especially in the Old World. With one exception, American genera are either identical with, or very closely allied to, those of Europe, and this resemblance is most marked when the species of the western half of the continent are compared with those of the Old World."

## Genus: Rumicia, Tutt.

Synonymy.—Genus: **Rumicia,** Tutt, "Ent. Rec.," xviii., p. 131 (1906). **Papilio,** Linn., "Faun. Suec.," 2nd ed., p. 285 (1761); Scop., "Ent. Carn.," p. 184 (1763); Hufn., "Berl. Mag.," ii., p. 80 (1766); Schiff. and Denis, "Schmett. Wien.," 1st ed., p. 181 (1775); Fuess., "Verz.," no. 606 (1775); Rott., "Naturf.," vi., p. 11 (1776); Bergs., "Nomen.," pl. lxv., figs. 5-6 (1780); Schneid., "Sys. Besch.," p. 235 (1785); Bkh., "Sys. Besch.," i., pp. 148, 272 (1788); Brahm, "Ins. Kal.," p. 137 (1791); Hb., "Eur. Schmett.," figs. 382-3 (1798); text, p. 54 (*circ.* 1805); Hb., "Raupen," etc., Pap. I., Gens A. b.c., figs. 1*a-c* (*circ.* 1800); Ill., "Schmett. Wien.," 2nd ed., p. 256 (1801); "Ill. Mag.," iii., p. 201 (1803); Ochs., "Die Schmett.," i., pt. 2, p. 87 (1808). **[Papilio-] Plebeius,** Müller, "Faun. Frid.," p. 37 (1764). **[Papilio-Plebeius-] Ruralis,** Linn., "Sys. Nat.," xiith ed., p. 793 (1767); Fab., "Sys. Ent.," p. 527 (1775); Goeze, "Ent. Beit.," p. 41 (1780); Fab., "Spec. Ins.," ii., p. 126 (1781); "Mant. Ins.," p. 80 (1787); Haw., "Lep. Brit.," p. 42 (1803). **[Plebeius-] Ruralis,** Esp., "Schmett. Eur.," p. 287, pl. xxii., fig. 1 (1777); pl. lx. (cont. x.), fig. 5 (1780); p. 62, pl. lxii. (cont. xii.), fig. 5, p. 72 (1780). **[Papilio-] Ruralis,** de Vill., "Car. Linn. Ent. Faun. Suec.," p. 70 (1789). **[Hesperia-] Ruralis,** Fab., "Ent. Syst.," iii., pt. 1, p. 311 (1793); Panz., "Schæffer's Icones," etc., p. 138, pl. cxliii., figs. 3-4 (1804). **Cupido,** Schrk., "Faun. Boica," ii., p. 208 (1801). **Polyommatus,** Latr., "Hist. Nat. Crust. et Ins.," xiv., pp. 116, 121 (1805); "Gen. Crust. Ins.," p. 206 (1809); "Enc. Méth.," ix., p. 670 (1819); Godt., "Hist. Nat.," i., p. 204, pl. x., fig. 1 (1821); Bdv., "Eur. Lep. Ind.," p. 11 (1829); Meig., "Eur. Schmett.," ii., p. 43, pl. li., figs. 5*a-c* (1830); Bdv., "Gen. et Ind. Meth.," p. 9 (1840); H.-Sch., "Sys. Bearb.," i., p. 134 (1843); Dup., "Cat. Meth.," p. 29 (1845); Wallgrn., "Skand. Dagf.," p. 198 (1853); Speyer, "Geog. Verb. Schmett., i., p. 253 (1858); Ramb., "Cat. Lep. And.," p. 35 (1858); Dbldy., "Cat.," 2nd ed., p. 2 (1859); Hein., "Schmett. Deutsch.," p. 91 (1859); Snell., "De Vlind.," i., p. 64 (1867); Nolck., "Lep. Fn. Estl.," i., p. 54 (1868); Newm., "Brit. Butts.," p. 115, fig. 38 (1869); Staud., "Cat.," 2nd ed., p. 9 (1871); Curò, "Bull. Soc. Ent. Ital.," vi., p. 109 (1874); Frey, "Lep. Schweiz," p. 13 (1880); Lang, "Butts. Eur.," p. 95, pl. xxi., fig. 4 (1884); Kane, "Eur. Butts.," p. 31 (1885); Auriv., "Nord. Fjär.," p. 9, pl. vii., fig. 23 (1888-91); Rühl, "Pal. Gross-Schmett.," p. 217 (1895). **Lycæna,** Fab., "Ill. Mag.," vi., p. 286 (1807); Leach, "Edin. Ency.," ix., pt. 1, p. 129 (1815); Sam., "Ent. Comp.," p. 241 (1819); Curt., "Illus. Brit. Ent.," fo. 12 (1824); Stphs., "Illus. Brit. Ent. Haust.," i., p. 79 (1828); Freyer, "Neu. Beit.," ii., p. 97, pl. 151, fig. 112 (1836); Ramb., "Faun. And.," p. 263 (1839);

Wood, "Ind. Ent.," p. 7, pl. ii., fig. 56*a* (1839); Westd., "Syn. Gen. Brit. Ins.," p. 88 (1840); Evers., "Faun. Volg.-Ural.," p. 64 (1844); Kirby, "Syn. Cat.," p. 343 (1871); "Eur. Butts.," p. 56, pl. xv., figs. 2*a-b* (1879); "Handbook," etc., p. 125, pl. li., figs. 5-6 (1896). **Hesperia,** Oken, "Lehrb.," i., p. 717 (1815). **Heodes,** Dalm., "Vet. Ak. Handl.," xxxvii., pp. 63, 91 (1816); Scudd., "Proc. Am. Acad. Arts Sci.," x., p. 187 (1875); "Butts. New Eng.," ii., p. 998 (1889); Dyar, "Nth. Amer. Lep.," p. 41 (1902); Chapman, "Ent. Rec.," xvi., p. 167 (1904). **Chrysoptera,** Zinck., "Allg. Lit. Zeit.," iii., p. 75 (1817). **Chrysophanus,** Hübn., "Verz.," p. 72 (*circ.* 1818): Stphs., "Illus. Haust.," iv., app. p. 404 (1834); Westd. and Hewits., "Gen. Diurn. Lep.," ii., 498 (1852); Sta., "Man.," i., p. 55 (1857); Kirby, "Eur. Butts.," p. 92 (1862); Butl., "Cat. Diurn. Lep.," p. 172 (1869); Buckl., "Larvæ," etc., i., p. 91, pl. xiii., figs. 4-4*c* (1885); Dale, "Brit. Butts.," p. 49 (1890); Barr., "Lep. Brit. Isl.," i., p. 62, pl. ix., figs. 2-2*j* (1893); Meyr., "Handbk.," p. 346 (1895); Tutt, "Brit. Butts.," p. 152 (1896); Staud., "Cat.," 3rd ed., p. 74 (1901); Lamb., "Pap. Belg.," p. 207 (1902); Wheeler, "Butts. Switz.," p. 18 (1903).

We have already shown (*anteà*, p. 313) that *virgaureae* is the type of *Heodes*, since Dalman cited this species alone in his generic synopsis (p. 63). Scudder's action, therefore, in fixing the type of *Heodes* as *phlaeas*, was *ultra vires*, and we, therefore, found it necessary to create *Rumicia* for *phlaeas* (*Ent. Rec.*, xviii., p. 131). Scudder gives an extremely detailed diagnosis of the genus under the name *Heodes*, his description (*Butts. New England*, ii., pp. 990-993) reading as follows:

Imago.—*Head* moderately small, densely clothed with scales, which are elevated to high tufts behind the antennæ, and furnished also with numerous hairs, above very long and arching forward, behind longest and downward, in front rather long, diminishing in length downward. Front flat, above a very little sunken down the middle, and, at the upper extremity, a distinct, narrow, rather shallow, longitudinal groove; on the lower two-thirds, a little full down the middle, at the bottom slightly tumid, barely surpassing at a single point the front of the eyes; less than half as high again as broad, of the width of the eyes as seen in front; upper border not raised, the corners considerably hollowed in front of the antennæ; lower border rather broadly rounded, the sides straight. Vertex scarcely elevated in the middle, laterally buttressing the antennæ, well separated from the occiput by a broad, pretty deep, transverse, nearly straight sulcation, deepest in little pits, in the middle and behind the antennæ; occiput slightly but broadly sulcated along the middle longitudinally. Eyes not very large nor full, naked. Antennæ inserted with their posterior edge in the middle of the summit, separated from each other by a space, equal to the width of the second antennal joint; half as long again as the abdomen, composed of 31 joints, of which 12 form the strongly depressed, elongated club, which is about three times as broad as the stalk, four times as long as broad, the first four or five joints increasing very gradually in size, beyond which the club is equal and terminates by the rapidly decreasing size of the last two or three joints, which form a very short but pointed cone. Palpi very slender, rather less than half as long again as the eye, the apical joint fully half the length of the penultimate, clothed only with recumbent scales, while the rest are densely clothed with erect scales, much the longest beneath and thinly fringed below with long straight hairs projecting forward and upward. *Patagia* comparatively broad and oval at base, the posterior half forming an equal, slender, straight, very bluntly-pointed lobe, scarcely one-third as wide as the base; the whole is fully three times as long as broad, the inner border slightly hollowed just before the middle, the outer deeply, at the base of the posterior lobe. *Forewings* three-fifths as long again as broad, the costal margin bent and slightly convex in the middle of the basal third, beyond very nearly straight, the tip scarcely curved downward, the outer angle abrupt, but rounded off; outer border slightly and regularly curved, inclining at an angle of about 75° to the costal margin; inner margin scarcely hollowed and angulated at the middle, the outer angle rounded off. Costal nervure terminating at the tip of the cell; subcostal with three superior branches; the first arising at the middle of the outer four-fifths of the cell; the second midway between the origin of the former and the apex of the cell; the third at, or barely before, the apex of the cell, forking midway between the base of the nervule and the end of its upper branch; cross veins transverse, obsolete,

scarcely perceptible even next the main veins; cell half as long as the wing and nearly four times as long as broad. *Hindwings* considerably and roundly expanded next the base, beyond, fully half-way to the tip, scarcely convex, then curving downwards rather rapidly and somewhat abruptly (♂), or roundly and not to so great an extent (♀); outer border broadly rounded, very slightly produced and angulated at the lower median nervule, slightly and roundly emarginate in the mediosubmedian interspace; inner margin broadly expanded at the base, beyond scarcely convex, slightly bent just before the straight apex, the angle abrupt and scarcely rounded. Submedian nervure terminating on the outer border, just beyond the anal angle; internal nervure terminating considerably beyond the middle of the inner margin. *Legs:* Fore tibiæ five-sixths the length of the hind tibiæ (♀), or scarcely shorter than they (♂); the spurs naked; fore tarsi fully as long as (♀) or a little shorter than (♂) the tibiæ; the last tarsal joint either similar to the same part in the other legs (♀), or small, tapering, armed with only a stout, apical, tapering spine, which differs from the other spines of the under surface which crowd up to it only in size, and furnished above with very short and dense hairs instead of scales (♂). All the femora provided with a fringe of rather close, long hair on the under surface. Middle tibiæ as long as (♂) or a little shorter than (♀) the hind tibiæ; armed beneath with rather short and slender, scattered spines and apically with a pair of rather long and stout spurs, only the tip bare. First joint of middle and hind tarsi rather strongly gibbous in the male; in the female of the usual appearance, considerably more than equalling in length all the other joints combined; second, third, and fifth joints about equal, the fourth smallest; joints armed beneath rather profusely with rather long and slender, scattered spines, mostly collected in crowded rows at the sides, an apical pair on each joint a little longer than the others, the under surface devoid of scales excepting on the first joint; claws small, compressed, not stout, tapering, finely pointed, falcate, but not very strongly curved; paronychia double, the superior lobe as broad at base as the claw, nearly straight, considerably exceeding the claw in length, the tip enlarged and very broadly rounded, almost docked; inferior lobe moderately slender, equal, the tip pointed, about as long as the claw and curving considerably both toward the claw and inward; pulvillus inconspicuous.

Genitalia.—Male, abdominal appendages with the lateral flaps of the upper organ forming bent and equal cylinders, the proximal halves parallel and enclosing between them a deep and equal mesial cleft, the distal halves bent downward and outward; lateral arms strongly arcuate, but not bent; clasps coarse, stout, bullate, several times longer than broad, well rounded.

Ovum.—Demi-echinoid in shape, the base being very broadly docked, flat, not curved at the edge, from which it is very broadly arched, not high; the cells are very large and conspicuous, bounded by heavy, elevated walls, are irregular in outline, but disposed in obscure, irregular, horizontal and oblique rows; the cells are smallest at the base, increase in size upwardly, largest on the upper portion of the sides and decrease again at and around the summit. Micropyle rosette lying on the floor of an infundibuliform cavity, and composed of minute cells, bounded by low, heavy walls.

Larva (newly-hatched).—Head broadest at summit, the sides as far as the bottom of the ocellar field tapering a little, scarcely convex; below tapering rapidly, the lower surface broadly rounded, crown of hemispheres broadly rounded, rather deeply and broadly cleft between them. Body largest at anterior extremity, tapering a little on the thorax, both as seen from above and from side, very slightly on the abdomen; posterior well rounded, above a little depressed, below greatly flattened, much as in the mature forms of the family. First thoracic segment furnished with a transverse, double row of very long hairs curving strongly forward over the head; remaining segments furnished as follows: first, a subdorsal row of hairs seated on high and slender papillæ, two on each segment, one central and exceedingly long, curving backward, and, when viewed posteriorly, curving first outward and upward and then upward and inward, tapering very slowly to a fine point, anteriorly very minutely spiculiferous, the other posterior and a little outside the former, not very long, nearly straight but turned backward, tapering, slender, finely pointed, apparently smooth; second, a ventrostigmatal row of hairs seated upon rather high papillæ, three on a segment, long and slender, quite straight, turned a little backward, very minutely spiculiferous on both sides, finely pointed; third, a laterostigmatal series of large, circular, crateriform papillæ or annuli, one in the centre of the 1st to 6th abdominal segments, and a similar papilla on the 7th segment in place of the smaller and outer subdorsal hair; fourth,

an infrastigmatal row of smaller, but still pretty large, papillæ, one in the centre of the 1st to 8th abdominal segments, and immediately behind them a minute, supplementary, posterior wart. Legs not very long, but moderately slender, the last joint tapering, the claw pretty stout, not greatly curved. Prolegs nearly sessile, the circle of hooklets very large, forming a circle or oval, open interiorly, nearly as long as the segment and containing ten very minute, but not very slender, moderately curving claws, separated from each other by a space more than equal to their thickness.

Larva (mature).—Head small, smooth, well rounded, broadest just below the summit, no broader than high, very slightly full on the sides at the broadest point and at the ocellar field, deepest in the middle, but scarcely narrowing above, the front broadly rounded on a lateral view, the triangle large, scarcely higher than broad, but reaching two-thirds way up the front, the sutures a little impressed; a few hairs on the triangle, labrum and lower part of the head. Antennæ long, the basal joint prominent, longer than broad, moderately stout, tapering; the second cylindrical, as large as the apex of the first, but only a little more than half as long as broad; the third as broad as the second, increasing a little in size at the apex, nearly twice as long as broad, the fourth minute, conical, sharply pointed. Ocelli six in number, four of which are placed close together, the lower two a little more separated than the others, in a strong curve, the arc of a small circle, its convexity forward, whose centre is occupied by the fifth ocellus; the sixth is placed below the others, a little outside of the extension of a line connecting the lower two of the curve, and as far from the lowest as that is from its neighbour; the central ocellus and the middle one of the anterior five are the largest, the lowermost the next, and the others equal. Labrum large, broad, longitudinally rugose, its front border very broadly rounded and but little excised. Mandibles slender, not broad, their edge oblique, very deeply dentate, the teeth being long and very slender, tapering, sharply pointed, rather distinct, five or six in number, and the space between adjoining ones roundly, deeply, excised. Maxillary palpi with the joints about equal in length, growing successively smaller, cylindrical, the terminal conical; inner palp resembling the terminal joints of the outer but smaller; spinneret conical, short, rather slender. Body regularly, equally, and considerably arched from one extremity to the other; the separate segments also rather prominently arched, especially in the middle of the body, and therefore quite distinct; viewed from above elliptical, the front end rounded a little more bluntly than the hinder extremity, scarcely tapering posteriorly. Dorsal field scarcely, if at all, depressed, but strongly arched and elevated on a cross section. Body very delicately and closely shagreened, covered with numerous, irregularly scattered, equal hairs, arising from nearly imperceptible warts; the hairs short, scarcely tapering, bluntly pointed, frequently and minutely, though coarsely, spiculiferous, the raised points scarcely directed towards the tip of the hair, but almost perpendicular to the surface of origin. Spiracles small, obovate, more than half as long again as broad. Legs short but rather stout, tapering rapidly, furnished on the inner side with bristles, the last joint rather slender and appressed, the claw rather long, compressed, heeled, moderately slender, curved a little, supported on either side by a long bristle. Prolegs very short and plump, furnished at the tip with a couple of short pads, each supplied with twelve to fourteen hooklets, arranged in a double row, so that all those of one proleg form an open crescent; the hooklets are long, moderately stout, tapering on the apical half, bluntly pointed, not strongly curved, distant from one another by fully twice the diameter of one of them.

Pupa.—Very little more than twice as long as broad; the sides of the body from one extremity of the wing to the other straight, or with a barely perceptible hollowing next the division line between thorax and abdomen, very slightly divergent posteriorly, so that the body is broadest at the 4th abdominal segment; here it is somewhat angulated, the posterior end tapering at once and forming an elliptical curve, the tip well rounded. In front of the wings the body tapers rapidly, and has a rounded, scarcely appressed front, the basal wing prominence being marked only by the angle the front part of the body makes with the wings. Viewed from the side, the flat bottom is uniform throughout; the posterior third of the thorax is very nearly equal, but slopes forwards a very little, its hindmost extremity a very little, the most elevated, roundly angulated in the middle of the posterior two-thirds, and sloping in front of it downward and forward about equally, scarcely curved. Abdomen very broadly arched above, highest, and a very little higher than the thorax at the 3rd abdominal segment, beyond the 4th abdominal segment with a pretty strong, downward curve, the lower edge of the 8th abdominal

segment being the most posterior point, the whole of the 9th abdominal segment directed forwards; the downward curve at the posterior is much more rapid than at the anterior extremity of the body. Transversely the middle of the thorax is well arched, the sides sloping away from each other at an angle of about 70°, with a scarcely perceptible hollowing, the summit rather broadly rounded; abdomen regularly rounded' forming an almost exact semicircle. More than three-fifths of the tongue exposed. Body covered equally with a very delicate tracery of slightly raised lines, crossing each other irregularly, and on the wings forming elongated, irregular, oval cells; at other places there is a little wart at the intersection of the lines; the surface within these cells is not infrequently occupied in part by an independent wart of similar size, giving rise to a fungiform papilla, the basal two-thirds of the pedicel slender and equal, the apical third rapidly expanding to a wine-glass-shaped disc, hollowed above, the horizontal edges of which are fringed with fleshy pointed cilia. Hooklets pretty long and exceedingly slender; the stem equal, straight on basal, slightly curved on apical, half; the expanded portion fully four times as broad as the stem, bent strongly over but not at all appressed to the stem, as the upper portion of this is curved, transverse, the sides turned backward considerably.

## Rumicia phlæas, Linné.

Synonymy.—Species: **Phlaeas,** Linn., "Faun. Suec.," 2nd ed., p. 285 (1768); Müll., "Faun. Frid.," p. 37 (1764); Hufn., "Berl. Mag.," ii., 1, p. 80 (1766); Linn., "Syst. Nat.," xiith ed., p. 793 (1767); Fab., "Sys. Ent.," p. 527 (1775); Schiff. and Den., "Schmett. Wien.," 1st ed., p. 181 (1775); Rott., "Naturf.," vi., p. 115 (1775); Esp., "Schmett. Eur.," pl. xxii., fig. 1 (1777); pl. lxii. (cont. xii.), fig. 5 (1780); Goeze, "Ent. Beit.," p. 41 (1780); Bergs., "Nomen.," pl. lxv., figs. 5-6 (1780); Fab., "Spec. Ins.," ii., p. 126 (1781); "Mant. Ins.," p. 80 (1787); Bkh., "Sys. Besch.," i., pp. 148, 272 (1788); de Vill., "Car. Linn. Ent. Fn. Suec.," p. 76 (1789); Fab., "Ent. Syst.," iii., pt. 1, p. 311 (1793); Lewin, "Ins. Gt. Brit.," p. 86, pl. xli., figs. 3-4 (1795); Hb., "Eur. Schmett.," figs. 362, 363 (1798); p. 54 (*circ.* 1805); "Raupen," etc., Pap. I., Gens A. b. c., figs. 1*a-e* (*circ.* 1800); Ill., "Schmett. Wien.," 2nd ed., p. 256 (1801); Schrk., "Faun. Boica," ii., p. 208 (1801); Haw., "Lep. Brit.," p. 42 (1803); Panz., "Schäeffer's Icon. Ins. Rat.," 2nd ed., pl. cxliii., figs. 3-4, p. 138 (1804); Latr., "Hist. Nat.," etc., xiv., p. 121 (1805); Fab., "Ill. Mag.," vi., p. 286 (1807); Ochs., "Die Schmett.," i., pt. 2, p. 87 (1809); Latr., "Gen. Crust.," etc., iv., p. 206 (1809), etc. **Virgaureae,** Scop., "Ent. Carn.," p. 181 *in part* (1763); Fuess., "Verz.," no. 606 (1775); Harris, "Eng. Lep.," p. 2 (1775). **Phleas,** Oken, "Lehrb. Zool.," i., p. 717 (1815). [N.B.—All other references mentioned under the generic synonymy (*anteà*, pp. 326-327) are referable to *phlaeas.*]

Original description.—*Papilio phlaeas* alis subangulatis fulvis nigro-punctatis, subtus albo marginatis; secundariis canescentibus. [Papilio hexapus; alis rotundatis fulvis; utrinque punctis nigris. "Fn.," 807. Merian, "Gall.," t. 164. Pet., "Mus.," p. 34, no. 317. Papilio minor aureus ex nigro permaculatus. Raj, "Ins.," 125, no. 20. Papilio parva, alis exterioribus circa margines nigricantibus, media parte rufis, serici instar splendentibus, maculis longis nigris pictis.] Habitat in pratis Westmanniæ. Descr.—Corpus sequenti (*virgaureae*) minus. Alæ primores supra fulvæ margine nigro, disco punctis nigris passim confluentibus. Subtus disco luteæ, punctis nigris annulo albo cinctis. Secundariæ supra fuscæ: postice fascia fulva posterius dentata; subtus canescentes punctis parvis, fuscis; postice fascia lineari rubra. Ad angulum ani alæ posticæ emarginatæ sunt, omnino ut in sequente (Linné, *Faun. Suec.*, p. 285).

Imago.—25mm.-35mm. The forewings of a bright coppery red tint, with black-brown hind margin; a transverse row of square black spots parallel to hind margin, black discoidal spot, another between this and base. Hindwings brown-black, with scattered coppery scales; bright coppery-red hind margin, edged with rim of blackish spots.

Sexual dimorphism.—Aurivillius says that the only sexual differ-

## Plate XVI.

*(To be bound facing Plate XVI.)*

### Rumicia phlæas.

Fig. 2.—Imago *Rumicia phlaeas* (just emerged, wings partly unfolded).
Fig. 3.— ,, ,, ,, (wings just expanded).
Fig. 1.— ,, ,, ,, (resting).
Fig. 4.—Larva $\times 1$.
Fig. 5.—Larva spun up ready for pupation (dorsal and lateral views) $\times 1$.
Fig. 6.—Pupa (dorsal and lateral views) $\times 1$.

### Heodes virgaureæ.

Figs. 7-8.—Pupa of *Heodes virgaureae* $\times 2$.

### Loweia amphidamas.

Figs. 9-11.—Pupa of *Loweia amphidamas* (three views) $\times 2$.

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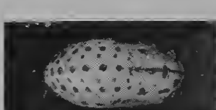

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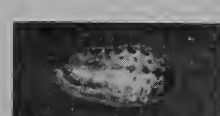

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*Photo. Hugh Main.*

LARVA, PUPA, AND IMAGO OF RUMICIA PHLÆAS. CHRYSOPHANID PUPÆ.

*Natural History of British Butterflies*, Dec., 1906.

ence observable in the species is that observed in the structure of the front legs throughout the family. There is, however, a marked difference in the general build of the sexes, in the shape of the wings, and in the general brilliancy of the colouring, the ♂ having more pointed, the ♀ more rounded or squared, wings; the ♂ also being more prone to darkening of the ground colour, the ♀ to a clearer and more brilliant tint, whilst the spots in the latter sex usually occupy a less proportion of the wing (see also *posteà* p. 337).

VARIATION.—The variation of *Rumicia phlaeas* is one of the most difficult subjects of which we have to treat. In the colour, one finds an enormous amount of variation, extending in the one direction to the change of the coppery-red ground colour to white, in the other direction to its suffusion with black to such an extent that some extreme specimens may, without exaggeration, be termed black. The aberration with the white ground colour, ab. *schmidtii*, is of occasional occurrence throughout the greater part of its range, being apparently most rare in extreme northern and southern localities, but the difference in the brilliancy of the coppery-red tint is largely a matter of geographical range, coupled with the season of emergence, as is also the strong suffusion shown in the darkest examples. In central Europe, for example, the specimens of the spring brood are bright coppery-red, so also are most of the summer examples, with, however, a strong tendency, in some, to suffusion, especially in hot seasons. In the northern parts of its range the coppery-red, although hardly so intense, is even lighter than the spring broods of the central area. In the southern and eastern parts of its area the specimens of the spring brood are bright, like those of the summer brood of the central area, but a large percentage of the examples of the summer broods are deeply suffused with black, often, in addition, with a distinct tail to the hindwings. This form is known as ab. (*et* var.) *eleus*. That these forms are really largely a result of temperature has been, to a great extent, proved by the experiments of Weismann and Merrifield, which may be here noted at length. In 1888, specimens of *R. phlaeas* were captured in the neighbourhood of Camaldoli, near Naples, and laid an abundance of eggs, of which some were reared at Naples by Schiemenz, others at Freiburg by Weismann.

(1) *The Neapolitan eggs reared at Naples.*—These were laid, in early May, on *Rumex acetosella*: the larvæ were fed up on this plant, and produced 36 butterflies between June 26th and 29th. These are all characterised by a very broad, deep, black margin on the upperside of the forewings, and by very large, deep, black spots; many also exhibit the black powdering of the brilliant red-golden ground colour characteristic of the var. *eleus*, but the latter character is very unstable, and very unequally developed. Three degrees may be separated, according to the extent of the black powdering on the forewings, as follows:—

α. *Darkest form*:—Only three to five small washed-out spots remain of the red-gold of the ground colour; all the rest of the surface of the wings is powdered with deep black, and only exhibits scattered red-golden scales, which produce a slight golden lustre. Only slight traces of red-golden spots can be recognised outside the band of black spots. Eight specimens of this form.

β. *Intermediate form*:—The red-golden ground colour is visible outside the band of black spots in the form of definite spots, but all the lower half of the wing is strongly powdered with black. Twelve specimens of this form.

γ. *Brightest form*:—The lower half of the wing, from the base to the band of

spots is powdered with black, which does not extend outside the same. Twelve specimens of this form.

Weismann says that all three forms merit the name of var. *eleus*, although they vary greatly just in the characteristics exhibited by the black powdering of the upperside of the forewings. This he considers a peculiar variability of the summer brood of *R. phlaeas* at Naples. He observes that a specimen from Greece, and one from Corsica, are even blacker than var. *a* (*suprà*), as they have no red-golden spots, but only a slight golden lustre, which results from scattered golden scales. He further notes that 71 specimens from Tokio, captured June and July, 1887, and, therefore, all belonging to the summer brood, have a very broad black margin, and large deep black spots, but the black powdering of the red-gold ground colour is also of very varying strength; only 3 are equal in darkness to the specimens just noted from Greece and Corsica, in many others only the basal part of the lower half of the wings is powdered with black, and 14 specimens are without any powdering, beautifully red-golden, so that here, also, great variability of the *eleus* character prevails.

(2) *The Neapolitan eggs reared at Freiburg.*—From part of the same lot of eggs, some 70 larvæ emerged between May 22nd-26th; the larvæ fastened themselves up from June 6th, but were, before pupation, divided into two lots, as follows:

*a*. Larvæ and pupæ kept at ordinary room temperature, from June 9th-13th, at 20°C., and from June 14th-22nd at 18°C. During this time 35 imagines emerged. Of these, 8 were decidedly *eleus*, the rest exhibited no black powdering of the red-gold, but all had broader margins of a deeper black, and larger spots than the German *phlaeas*, and even than Sardinian *phlaeas* of the spring brood.

*β*. These larvæ were, at the commencement of pupation, placed in the cellar, or refrigerator. As pupation, at the temperature of the latter, 6°C.-10°C., did not take place, they had to be subjected to a temperature a little over 10°C.; under these conditions pupation was delayed for some time, and took place between June 22nd to July 25th. The pupæ were then kept in the refrigerator at from 7°C.-10°C., where several butterflies emerged between August 27th and September 16th. It was evident that the dampness of the refrigerator not infrequently rendered the red quite pale yellow, so some of the pupæ still remaining were brought into a room, where 18 more butterflies emerged between September 17th and October 18th. The rest remained in the refrigerator, and later emerged at 10°C.-11°C., most of them crippled, although very few to such an extent that the colour could not have been recognised. In reference to brilliancy of colour, it was all one whether the imagines left the pupæ in the refrigerator or in the room. Of the 51 butterflies that emerged, only 2 are somewhat powdered with black, one of which emerged August 27th, the other on September 15th. All the others are bright red-gold, and have very small black spots; but the majority have a broad and deep black margin, and, especially, the black of the apex of the wing often spreads to the uppermost spot of the band of spots, while, at the same time, it extends as a broader stripe along the costa to the base of the wing. These are characters which are not present in German specimens: and is such a mixture of characters of the southern and northern forms as is unknown to one in specimens captured at large. The duration of a lower temperature for a very long time does not produce any increase of the effect that can be recognised. To be sure, the two darkest specimens emerged tolerably early, *viz.*, on August 27th and September 15th, but perfectly bright examples emerged on August 31st, September 5th, 6th, 7th, and 10th, and then, again, some rather darker specimens on September 20th.

(3) *German eggs reared in Germany.*—Eggs laid by captured ♀ at Leipzig, in August, 1889. On August 20th, placed in a room with a temperature of 10°C. The first larva hatched August 27th; all the eggs then placed in a hothouse where temperature fluctuated between 20°C. and 30°C.; all the larvæ, 35, appeared between August 27th and

31st. On September 12th, they were placed in an "incubator," the temperature kept at about 27°-29°C., pupation taking place therein between September 15th-24th—25 pupæ in all, which produced 23 butterflies between September 19th and October 5th, the remaining pupæ not emerging. The temperature of the incubator was gradually raised from 24°C. on September 25th, to 38°C. on September 29th. The imagines divided as follows:

α. Eight specimens closely resembled the ordinary German *C. phlaeas*, so that the raised temperature had no effect on them.

β. Two specimens can be described as var. *eleus*, as they are as strongly powdered with black as many specimens of the darkest variety of the butterfly reared at Naples. Both specimens emerged on September 27th, *i.e.*, two days before the end of the period of emergence, and, consequently, were not subjected to the highest temperature, 37°C.-38°C., but only to a temperature of 23°C.-29°C.

γ. Thirteen specimens are somewhat darker that the ordinary German form. They have the black margin a little broader, the black spots somewhat larger. The black powdering of *eleus* is also present to a very slight extent, and principally on the lower half of forewing, from base towards the band of spots only. A sharp distinction cannot be drawn between these and the unaltered ones first mentioned.

As a summary of the results, it will be noted that the eggs of Neapolitan butterflies more frequently produced butterflies powdered with black at Naples than when reared at Freiburg in a room at ordinary summer temperature, and resulted in butterflies without any black powdering when the pupa were kept at 6°C.-10°C.; on the other hand, eggs from north German *phlaeas* produced two specimens powdered with black, similar to Neapolitan *eleus*, when the pupæ were subjected to 24°C.-38°C. Weismann considers that experiment 2 (*suprà*) proves that temperature only operates during the pupal period, its operation during the larval period being without effect, since the Neapolitan larvæ, all reared at the same room-temperature, and only treated differently during and after pupation, produced strikingly different coloration in lots α and β. He thinks that there can be little doubt that there is a greater tendency towards black colouring in the southern summer broods, although the spring brood in the south is as pure red-gold as in central Europe, etc. Merrifield's experiments (*Trans. Ent. Soc. Lond.*, 1893, pp. 63 *et seq.*) tend to show that the difference in appearance, between the *phlaeas* from southern Europe and England, is not necessarily to be attributed to the existence of races of different colouring, but may be due to the difference between the temperatures to which the individuals are exposed in the two climates. Starting with eggs laid by English *phlaeas*, he obtained 70 pupæ, and forcing (or retarding) them at different temperatures, obtained results as follows:

α. Ten pupæ. Forced at 80°F.-90°F. (representing a very hot continental summer temperature) (figs. 1 and 1*a*). Emerged in six days. Spots large, not sharply defined; dusky suffusion of forewings.

β. Six pupæ. Temperature of room, about 70°F. (English summer temperature). Emerged in 11-15 days. Spots smaller; copper colour more vivid; black more intense.

γ. Six pupæ. Placed in a cool shady place out-of-doors, 56°F.-58°F. (rather cool summer or late spring temperature). Emerged in 22-23 days. Copper colour still more vivid; copper band on hindwings broader.

δ. Ten pupæ. Placed in a cellar at uniform temperature of about 56°F. Emerged in 29-33 days. These are very similar to last lot.

ε. Six pupæ. Placed in refrigerator at about 47°F. (temperature of cold spring). Only three emerged, and these took 57-59 days to develop. Effects noted in γ and δ intensified.

ζ. Number unstated. Kept at 33°F. for ten weeks, then at 55°F. for five weeks (winter and spring temperatures) (figs. 2 and 2*a*). About half died or were crippled. In those which emerged all the effects of the low temperature are shown in their extreme—light colour of coppery parts, reduced size of spots (one or two of which have almost disappeared); the breadth and conspicuousness of the coppery band on hindwings, which ceases to be serrated, though coppery scales are often prolonged along nervures, from band towards base of wings.

η. Six pupæ. Exposed at 33°F. for nine or ten weeks, then at 90°F.; all emerged in from 5-6 days. These have most of the features of lot α, which were never at a lower temperature than 80°F.-90°F., and especially the dusky suffusion of bases of forewings, and reduced size of coppery band on hindwings. The contrast in colouring between these and the last lot, ζ, is noticeable.

Merrifield observes that the principal effects on colour appear to be produced, not by long exposure to severe cold, but by exposure, during the period when the active part of the pupal changes has begun, to (1) great heat, producing duskiness; (2) moderate cold, producing vividness and intensity of colouring in both the coppery and the dark parts, smallness of spots, and great enlargement of the copper band on the hindwings. Merrifield further remarks the interesting parallelism apparently produced naturally by temperature in the American insect—*R. hypophlaeas*, of which, Scudder remarks that the spring individuals (*i.e.*, those which emerge in colder weather) are of a more fiery red, and the orange band on the undersurface of the hindwings is broader; while, in later broods, *viz.*, those emerging in the hot American summer, the markings are less vivid and less distinctly defined. He adds that there is also a longer tooth on the margin of the hindwings, a feature that appears to exist in a slight degree in the *phlaeas* reared by Merrifield at a high temperature, the orange band on the undersurface of the hindwings being, in all these examples, very inconspicuous. Frohawk, however, notes that the markings on the undersides of all the wings are considerably stronger in those exposed to high, than in those developed at lower, temperatures, and in those at the lowest temperature the spots on the forewings are much reduced in size, and on the hindwings are almost obliterated. Weismann's comparison of these experiments (*Ent.*, xxix., p. 38) is interesting, and there is no doubt that the difference observed in the appearance of the specimens is merely due to a modification of the chemical processes in the development of the colour-material in the scale in which a high temperature produces darkening, and moderate cold a brightening of the colour. It is clear, however, that the changes that may be produced artificially are limited by the racial variation exhibited in this species in the widely different latitudes that it inhabits, and that the races of warm climates react more readily to higher, and less readily to low, temperatures, whilst those from cold climates react more readily to low, and less readily to high, temperatures. Weismann gives (*Ent.*, xxix., pp. 74 *et seq.*), too, considerable details of the variation in the markings of *phlaeas*, independent of climate. He notes, with regard to the development of blue spots on the outer margin of the upperside of the hindwings in both sexes, that as many as four may be present, but often one or other of the spots is only indicated by scattered blue scales, frequently only by a single one, and not infrequently no trace of the spots is to be seen at all. If specimens from the south be compared with those from the north, it is seen that well-developed spots and their indications are much more frequent, but

that no correspondence exists between climate and the degree of perfection of the spots. He illustrates this by noting that, in his collection, the following facts are observable :

1. *With 3-5 well-developed blue spots.*—One example from Lapland ; 1 from Sardinia (spring brood) ; 1 from Corsica (summer brood) ; 1 from Lindau (summer brood) ; 3 from Japan (summer brood) ; 8 from Japan (spring brood) ; 2 from Naples (reared at Freiburg at a room temperature) ; 3 from pupæ developed at 7°C.-10°C.

2. *With slight indications of blue spots, i.e., exhibiting blue scales in fewer number and more scattered.*—One example from Lapland ; 3 from Sardinia (spring brood) ; 10 from Genoa (summer brood) ; 3 from Greece (summer brood) ; 2 from Berlin ; 4 from Lindau ; 12 from Leipzig (pupæ at 27°C.-31°C.) ; 28 from Japan (summer brood) ; 14 from Japan (spring brood) ; 14 from Naples (reared at Naples, summer brood) ; 23 from Naples (reared at Freiburg at room temperature), 6 from Naples (pupæ developed at 7°C.-10°C.).

3. *Without a trace of blue.*—One example from Genoa (*eleus*) ; one from Greece (*eleus*) ; 3 from Lindau (summer brood); 8 from Leipzig (kept at 24°C.-30°C.); 7 from Japan (spring brood).

The largest and most beautiful blue spots are possessed by some Japanese specimens of the summer and spring broods, one Sardinian, and one Lapland, example. The blue spots are consequently individual variations, formed everywhere under the most varied temperatures, often appearing only slightly, and, still more frequently, only suggestively, as single blue scales. Weismann also notes, relative to the red band on the underside of the hindwing, that there are, on the grey-brown ground colour of the underside of the hindwings of *phlaeas*, brick-red lines along the outer margin, referred to in books as "confluent reddish lunules"; they are, in reality, very often distinct as separate lunules in cells 1-5, but they are frequently also joined together in a line running in an almost zigzag shape, from which the red spreads inwards to a narrow washed-out band. This red marking varies, but, as it seems, independently of temperature; and is local to the extent that individuals of a particular district all seem to present an almost equal development of it, *e.g.*, 72 Japanese specimens, of the summer brood, have a broad and vivid brick-red coloured band, in opposition to the specimens from all other countries with which he was able to compare. Felder founded, indeed, his *chinensis* on this peculiarity. Specimens from north Germany always have only a narrow red line or disconnected marginal lunules, which are sometimes strongly, sometimes slightly, brick-red; the Lapland specimens also have these lines very distinct, just as the south German and Berlin specimens, and also most specimens of *eleus* from Greece, Corsica, and Genoa; sometimes, indeed, the red is very dull, yet never entirely missing. The lunules, which are the feeblest in colour, and most washed-out in marking, are those of the Neapolitan specimens, which were subjected to the cold as pupæ; and, so far, consequently, the formation of this character depends upon the temperature, etc. We have already explained (*Ent. Record*, vi., pp. 185-186) what we consider the causes of the colour-variations produced artificially in this species. The attempt to produce a "tail" in the summer brood of *R. phlaeas*, is also commented on by Weismann. He says that a short tail on nervure 2 of the hindwing, and a pointed prolongation of the anal angle is given as a character of *eleus*, yet it is not confined to this form, but is also occasionally, though more rarely, present in the pure red-gold form. He suggests that the tails can be arranged in three

grades as "well-developed," "medium," and "slight," and he observes that captured specimens exhibited this grading as follows:

1. *Well-developed tails.*—One example from Lindau; one from Freiburg; one from Berlin (*eleus*); one from Sardinia (first brood); eleven from Genoa (second brood, mostly *eleus*); two from Greece (*eleus*); one from Sicily (*eleus*); many from Japan (summer brood).

2. *Medium tails.*—One example from Lindau; one from Freiburg; one from Sardinia (first brood); one from Greece (*eleus* ♀); many from Japan (second brood); some from Japan (first brood).

3. *Slight tails.*—Two specimens from Lapland; two from Sardinia (first brood); many from Japan (first brood).

The captured examples show that the tail is more often present in the summer brood and in a hot climate, than in the spring brood and in a northern climate, a conclusion supported by the fact that, of the 32 Neapolitan specimens reared at Naples, 30 had them well-developed, and 2 medium, and none had them only slightly. The examples reared from Neapolitan eggs at Freiburg, at a living-room temperature, produced 8 with well-developed, and 13 with medium to slight, tails. The examples from Neapolitan eggs reared like the last, but from pupæ placed in a refrigerator, produced 15 specimens with medium to slight tails, and 11 specimens with them entirely wanting. The development of these structures, therefore, appears, in Weismann's opinion, to be connected with temperature operating during pupal development. Chapman gives (*Ent. Rec.*, xvi., pp. 167 *et seq.*) some most interesting notes on the variation of this species, more particularly in western Europe, and he records the following general conclusions on some observations made on specimens from various British and extra-British localities, and exhibited at the South London Entomological and Natural History Society: (1) *Size:* This does not seem to depend on place or season, but on the period spent in the larval state, though there is much variation in any one locality, as temporary strains that are hereditary. There is thus some tendency for the more northern specimens to be the larger, the Lapland specimens examined being amongst the largest. These are also the only certainly single-brooded specimens shown; the species is, however, usually single-brooded in Scotland. The most uniformly small specimens shown are those bred this autumn (1903) at Reigate. These were reared at a temperature not less than 85°F. throughout. They had plenty of food of good quality, and their rapacity and continuous feeding struck one very much, as well as the very few days they took to feed up. Their small size is due, therefore, to rapidity of growth, and not in any way to starvation, development outstripping the possibilities of the mere mechanics of eating. Nevertheless, it seems very frequently the case that the *eleus* form presents very large specimens. The *phlaeas* form may be small from starvation, having passed the winter as larva, whilst the summer form may have fed up slowly on fine fresh grown food in the cooler early summer, and have only been submitted to an *eleus*-producing temperature when it has reached the pupal stage. (2) *Form:* There seems considerable difference in the sharpness of the apical angle, the wing looking short and square in some specimens and long and pointed in others. The difference is not perhaps very great, and setting may sometimes exaggerate the appearances. Still two specimens from Arcachon and two from Susa that have been selected, seem very pointed, and two from Torre Pellice very square, others from these same localities are otherwise, and one is

unable to associate these forms with either place or season. *Tails:* One point as regards form is the development of tails. No large pale specimen has any development of tails, in the dark ones there is great variation, but there seems to be a tendency for the tails to be better developed in the small than in the large ones. *Sexual differences:* Although unable in many cases to distinguish the sexes of the specimens, yet it appears to be usually the case that the pointed-winged specimens are ♂ s and the square ones ♀ s, a sexual dimorphism that is common to the rest of this group, and very notable in its near ally *Loweia dorilis*, to which also some (♂ ?) specimens approximate in having, not the tail, but the anal angle somewhat produced. (3) *Colour:* Apart from the greater or less abundance of black scales there is a difference in the richness or paleness of the copper colour, as a rule, the darker specimens having the richer colour. The greatest variation in colour is in the amount of black scaling. This occurs in two very distinct ways, *viz.*, by greater extension of the black areas, spots, hind margin, etc., and by the invasion of the copper area by a suffusion of black scales. The former not unfrequently occurs with hardly any of the latter, but suffusion of the copper is almost always associated with some increase of the black areas. The evidence of the specimens submitted is to the effect that both these features are the result of heat in the earlier stages, that is, that they are entirely climatic, and in no definite way geographical or racial. There are specimens that might be ordinary English ones from France, Switzerland, Italy and Spain, and all intensities of suffusion occur through ab. *suffusa* to var. *eleus*. The Locarno examples are interesting. Specimens, taken in 1902 immediately after a very cold spell, during which they were no doubt in pupa, were ordinary typical specimens though emerging in May; in April, 1903, the specimens approached ab. *suffusa*, though taken in April; the weather was then cold, but had just before (when the specimens were in pupa, doubtless) been fairly warm. What causes some specimens to confine the darkness to increase of spots, and others to add suffusion, is not at all elucidated. Those that affect suffusion, often have the spots with a sort of halo around them, that is not the deep black of the spots, nor yet suffusion of the copper. Chapman's specimens, he says, reared in heat, are remarkable as having the spots and margins much increased, so that the spots form a continuous band, yet they are very well defined, and the copper in most of them is bright, only one of the captured specimens is quite like them, one from Bronchales (central Spain). The pupæ of some of the specimens reared by Chapman were kept very damp, others very dry, but there is no difference in the resulting butterflies. Amongst Pickett's captured English specimens are several that are quite the form *suffusa*, and one or two approach, in some degree, Chapman's bred ones, showing that it is climate and not our race of *R. phlaeas* that prevents *eleus* being a common form with us. They also show that the want of suffusion in these bred specimens has nothing to do with the type of the race, though, whether it arises from some special cause in their treatment, or is hereditary in the actual brood experimented with, cannot be determined. Chapman does not deal with aberrations, so says nothing about *schmidtii*, and forms named by Oberthür and others, but he refers to the Lapland form. This, he says, is large, pale, tolerably typical above, except that the black spots of the hindwing

are much more easily seen than in the type, and, perhaps, that the blue spots are the rule, rather than, as elsewhere, the exception. Beneath, however, the black spots of the underwings, and the orange marginal line, are pronounced in a way that no other form approaches. Staudinger calls this *hypophlaeas*, Boisd., and says that it is identical with the American form. Though Scudder regards the American form as abundantly distinct from the European, he does not appear to have been aware of the identity of the Lapland form with the American (some of the specimens exhibited agree exactly with his description of the American form), whilst it is difficult to regard the Lapland form as distinct from our ordinary form, though we possess no specimens from intermediate districts to show the gradation. Chapman is not quite sure, but thinks the "warm" varieties have the underside of the hindwing distinctly of more uniform tint and freer from spots and orange marginal line than the type. He mentions that Merrifield has shown that the effect of a high temperature in producing dark specimens of *phlaeas*, takes place during the pupal stage, whilst the imago is maturing within it, and that warmth in an earlier pupal, and in the larval, stage, has little or no effect. He adds that "we speak of the difference between *phlaeas* and *eleus* as a seasonal one, but this is not strictly correct. It is an individual change due to the direct action of temperature, there is no distinct alternation of forms as in *Araschnia levana* and *prorsa*, or as in our English Ennomids, alternations which Merrifield found he could break through only with difficulty. In *R. phlaeas* each individual is prepared, up to the pupal stage, to take either form. How then, he asks, may we arrange the ordinary (*i.e.*, not aberrational) forms of *phlaeas* (west European)? We may, with little hesitation, accept *hypophlaeas* as a distinct geographical race or subspecies. When we come to *eleus*, we must, I think, in the first place use the name in two senses; it is primarily the name of the darkest form of *phlaeas*. It must also be given to the southern race of *phlaeas*. The experiments of Weismann, Merrifield, Standfuss, Fischer, etc., bring out apparently, that the southern races respond with much greater readiness to the proper temperature stimulus that produces *eleus*, than the central European form does. There also exists a belief that the normal (cool) form of this southern race is darker than central European *R. phlaeas*. In some cases this is probably true. Whether essentially darker, or merely responding more easily to stimuli to become darker, it has a sufficiently different constitution to be recognisable as a race, though not, perhaps, so definitely a subspecies as we may take *hypophlaeas* to be. The name of this southern subspecies would necessarily be *eleus*. We cannot but recognise, however, that English *phlaeas* can provide *eleus*, and very commonly takes the transitional form of *suffusa*, Tutt, whilst specimens exhibited demonstrate that, to the south of the Alps and in Spain, the race *eleus* can produce tolerably typical examples of *phlaeas*. We have then:

| | | | | |
|---|---|---|---|---|
| *Rumicia* | *phlaeas*, | *phlaeas* f.t. | *phlaeas* | Central Europe. |
| ,, | ,, | ,, | ,, *eleus* | |
| ,, | ,, | *eleus* | ,, *phlaeas* | South Europe. |
| ,, | ,, | ,, | ,, *eleus* | |
| ,, | *phlaeas*, *hypophlaeas* | | | Lapland. |

It must also be recognised that *eleus*, besides such transitional forms as *suffusa*, presents a large, dark, suffused form, and a smaller,

brighter, clearer form, with the dark marking increased, but not suffused. Pickett's captured specimens from Dover present no extreme form, but demonstrate clearly that English *R. phlaeas* varies in the intensity of the copper, and varies a considerable way towards the darkening that constitutes *eleus*, both by increase and by suffusion of black, whilst I believe that many English collections contain fully-developed *eleus*. One of this year's (Dover, August) specimens is *suffusa*, well on towards *eleus*, so that, even in a year (1903) like the present, examples succeed in finding warm places in which to pupate. A Dover specimen of August, 1902, is nearly as dark, as well as two or three May specimens from Clandon. They have all been obviously selected as nice specimens and represent rather the well-marked and rich-coloured examples, and do not fairly show a normal proportion of paler copper, with smaller spots and narrower border. The majority are, in fact, though not by a good way as far as *suffusa*, yet an appreciable distance on the way to being *eleus*. It is curious this should be even more the case with the May (1902), than with the August specimens (Dover, 1901, 1902, 1903). Carpenter's beautiful exhibit of about 112 bred specimens of three several broods, from three parents, showed each brood to be of tolerably uniform type and so far different from the others that it might almost have been possible to separate them again had they been mixed together; yet the total difference was not great. All were reared in an unheated greenhouse, and the uniformity of each brood may be referable to the uniform conditions under which all its individuals were reared, but more probably arose from an hereditary identity. The parents were not exhibited with them. All were very fine bright specimens, a little more darkly marked, perhaps, than an average of English captured examples. Specimens emerging in July, 1896, from an Abbott's Wood parent, were well spotted, and some, emerging July 15th-21st, slightly suffused. Those of June, 1897, from Folkestone parents, were paler with smaller spots (cooler period of emergence). From a Bude parent, specimens, emerging September, 1902, were larger, brighter, and well spotted. Montgomery's series had, unfortunately, nothing but memory to co-relate the specimens with the facts of their education. They formed a long series of about 300. They were from four ♀ s taken at Greenford, Middlesex. The four broods were raised together. Eggs laid August 5th-31st. There was considerable mortality in the larvæ and some of those that were smallest on September 24th were turned out. The first emerged September 13th, and up to October 9th, 240 emerged. On October 6th, the temperature fell decidedly, especially the night temperature, and remained low for two or three weeks; 60 emerged during, and just after, this period—October 10th-20th, 50; October 23rd-28th, 9; and one on November 7th. Of the whole number five or six are slightly suffused and with dark veins. These were amongst the earliest emergences (up to the date of first emergence the mean maximum temperature was 71·2°F.). Amongst the mass of emergences of ordinary aspect were five remarkable for their small size (about 19mm.), and not very different from 20 to 25 that emerged amongst the last 50 or 60, of which some were as small as 21mm., these were also pale in the copper and rather weakly spotted. Apart from discoverable temperature effects, some specimens were remarkable for having the row of spots less in pairs than usual, but more in a

continuous sweep (like those of *Chrysophanus hippothoë* and *Loweia amphidamas*), and others had them very close up to the discal spot; there is much variation in width of dark margin, and exact position and size of spots, without anything strikingly extreme. Blue spots were fairly represented in all forms. The American *R. hypophlaeas*, as described by Scudder, agrees very closely indeed, as has been already noted, with the Lapland form. The specimens differ in one point. The three large apical spots that lie in a slightly curved line, one in each interneural space, are continued, in my specimens bred at 95°F., by one or two others, in the next one or two spaces, that continue exactly the sweep of the curve of the three below. Average English and many European examples are without any trace of these extra spots, and Scudder makes no mention of their occurrence in any American forms. In the European specimens, the first of them is not unfrequently present, but does not continue the line of the three below, and occupies a more apical position. This spot is always present (or almost always) in the Lapland specimens, and, in them, is very decidedly more apical, so as to seem moved outward, just as the lowest of the three is beyond the upper one of the pair below. In a considerable proportion of the Lapland specimens the second of these extra spots is present, and lies in the line of the three spots, without reference to the dislocation of the preceding one. Beneath, the spots are repeated, and where both are present, they look like a pair standing above, and one to either side of, the top of the three usual spots. Although the dislocation of the first extra spots is so variable in amount, or even absent (as in my bred ones), I have not seen sufficient specimens possessing them to say how far it marks a peculiarity of race. It is certain, however, that this pronounced development of these spots in the Lapland specimens, contrasts very decidedly with their absence in American forms. One would, however, expect to meet with them in some American specimens, even although so careful an observer as Scudder had not seen them." Chapman further notes that Moore showed a specimen from the Himalayas, from whose upper wings all copper had disappeared, except a few spots outside the row of spots, though the hindwing was nearly typical and with blue spots; whilst American specimens from Indiana (U.S.A.), Cape Breton and Halifax, were small (26mm.) but otherwise very like the Lapland specimens. Several of the eastern and south-eastern forms have been specially named, *e.g.*, *oxiana*, Gr.-Gr., *chinensis*, Feld., *comedarum*, Gr.-Gr., etc., but there has been no suspicion of any want in their specific connection with *phlaeas*. Concerning the American form, however, much doubt has arisen, as has already been suggested, and many lepidopterists still consider it distinct. Whether this be so, or not, we are not prepared to say, but give herewith Scudder's notes on the variation (and life-history) of the American insect. He says: "According to Pryer, *phlaeas* is very strongly affected by temperature; the first brood, which appears in Japan in March, is very brightly coloured, while the later summer broods are much darker, and the male almost black. Zeller makes a similar statement concerning Sicilian specimens, though, in Switzerland, according to Meyer Dür, the differences are not nearly so great. In *H. hypophlaeas* (*americana*), also, we find such differences, but whether they vary in the north and south I do not know. Specimens of the spring brood in Massachusetts are of a more fiery red, and the

orange band of the under surface of the hindwings is broader; while, in the later broods, the markings are less vivid and less distinctly marked, and there is a longer tooth on the margin of the hindwings." Scudder's detailed account of the American insect (together with Boisduval's original description) is given later. Frohawk observes (*Ent.*, xxvi., p. 294) that, in 1893, at Balham, among a large number captured, were specimens varying from $\frac{7}{8}$in. to $1\frac{2}{5}$in., thus differing in size more than $\frac{1}{2}$in. The colour of all was very brilliant, varying from light golden-copper to deep fiery-copper, whilst two approached var. *schmidtii*, one having the left forewing pale silvery-gold, shading into copper at the base, the other with the right forewing silvery-white. The size of the spots in different specimens varied from small dots to bold blotches. Two examples, he says, are exceptionally fine aberrations, having the copper bands of the secondaries replaced by a black band formed by the enlargement of the submarginal velvety-black spots, and the ground colour of these wings lustrous steel-grey; in one, a few of the nervures show coppery scales, whilst the other has only the merest trace of copper on one or two nervures; both are females. In the other specimens, the coppery band varies in width; in one, the copper is extended along the nervures, and the rest of the wing is sprinkled with copper scales. The blue spots, which sometimes occur on the secondaries, are, in one of the specimens under consideration, conspicuously shown, and are five in number on each wing; these spots are also present, but less apparent, in two other examples. He then goes on to argue that the specimens present facts that are adverse to Merrifield's views on the effects of temperature on the colouring of *R. phlaeas* (*Trans. Ent. Soc. London*, 1893, p. 62), etc., as he quite expected to find the majority of specimens with the copper colouring dull and the black markings pale, corresponding with Merrifield's high temperature forms, because (considering the vast numbers he saw on the same piece of ground at the same time, all having evidently been bred close by) they must necessarily have all been subjected to high temperatures during their various stages, and especially while in the pupa, as the temperature, both day and night, remained very high for weeks previous to, and at the time of, emergence, yet he found his expectation exactly reversed, as all the insects he examined were of brilliant colouring, the copper being rich and bright, and the black deep; in most cases, indeed, they closely resembled his low temperature forms. Merrifield observes (*Ent.*, xxvi., pp. 333 *et seq.*) that the specimens obtained by Frohawk are quite consistent with his recorded experiments, and points out that, although the summer of 1893 was a very hot one, yet, during the time that the captured specimens were in pupa, the average mean daily temperature of the southeast of England was less than 65°, and, during the critical twelve days only about 60°, and that the recorded temperature of the time they were pupæ in no sense approached the 80° and upwards to which the pupæ dealt with in his "high temperature" experiments were subjected. Merrifield adds that Frohawk's specimens corresponded very well with those reared in his experiments at low temperature, *e.g.*, 56°-58°, etc.

### The North American forms.

The North American race of this species has been variously known as *hypophlaeas* and *americanus*, and appears to be, on the whole, little

less variable than the Palæarctic insect. No form so white as our ab. *alba*, usually, but erroneously, called *schmidtii* has yet been taken there, but an approach to our ab. *intermedia* is found in the *fulliolus* of Hulst, whilst two of our best known European forms, ab. *obliterata* and ab. *fasciata*, were first described from American specimens. [Reference to these must be made (*posteà*).] It is quite clear from Maynard's note (*Butts. New England*, 1886, p. 41) that most of the European aberrations that show variation in the spotting of the forewings occur in North America as frequently as they do in Europe, whilst the suffusion noted in our summer examples in the Palæarctic region is also recorded from North America, Weir observing (*Ent.*, xvii., p. 50) that *phlaeas,* taken at Moose (Hudson Bay), has the wings suffused with black, with but very faint traces of orange visible, both sexes being as dark in colour as ♂ *L. dorilis*. Chapman has already pointed out the characters of the American race, and made (*anteà*, pp. 337-338) some comparisons between this and Scandinavian examples. Schneider says (*Tromsö Mus. Aarsheft.*, xv., p. 20) that "all the Scandinavian Arctic specimens belong to var. *americanus*, distinguished by the lighter bluish-green underside, and apparently the much stronger and more sharply defined black dots on the underside of the hindwings. He says, further, that it is difficult to find any constant characters on the upperside between the northern and southern Scandinavian examples, although the distribution of red and black appears to be more variable in the north, especially as regards the hindwings. He thinks that *R. phlaeas* reaches its finest and largest development in the northern areas of its distribution, *e.g.*, the largest ♂ from Tromsö measured 28mm., an expanse greater than that of his examples from central and southern Europe. He adds that Arctic examples are also distinguished by their light and bright yellowish-red colour.

*a*. var. (*an* spec. dist.) **Hypophlaeas,** Bdv., "Ann. Soc. Ent. Fr.," 2nd ser., x., p. 291 (1852); Morr., "Syn. Lep. Nor. Amer.," p. 84 (1862); Scudd., "Bull. Buff. Soc. Sci.," iii., p. 128 (1876); Streck., "Cat. Am. Lep.," p. 101 (1878); Scudd., "Butts.," p. 166, figs. 4, 7, 25, 42, 58, 105 (1881); Edw., "Rev. Cat. Lep.," p. 59 (1884); French, "Butts. East. Un. Sta.," pp. 283-4, figs. 75-77 (1886); Scudd., "Butts. New Engl.," ii., pp. 998 *et seq*. (1889). **Americana,** Harr., "Ins. Inj. Veg.," 3rd ed., pp. 273-4, fig. 104 (1862). **Americanus,** D'Urb., "Can. Nat.," v., p. 246 (1860); Morr., "Syn. Lep. N. Amer.," p. 91 (1862); French, "Rept. Ill. Ins.," vii., p. 158 (1878); Fern., "Butts. Ma.," pp. 89-90, figs. 27-28 (1884); Schöyen, "Ent. Tids.," vi., p. 141 (1885); Mayn., "Butts. New Eng.," p. 41, pl. v., figs. 52 *a-c* (1886); Staud., "Rom. Mém.," vi., p. 156 (1892); Schneid., "Troms. Mus. Aarsh.," xv., p. 20 (1893). **Phlaeas,** Godt., "Enc. Meth.," ix., pp. 609, 670-671 (1819); Bdv., "Lep. Am. Sept.," pp. 123-24 (1833); Harr., "Hitch Rept.," p. 590 (1833); Emm., "Agr. New Yk.," v., p. 216, pl. xlvi., fig. 4 (1854); Morr., "Syn. Lep. N. Am.," p. 84 (1862). **Hypophleas,** Staud. and Reb., "Cat.," 3rd ed., p. 74 (1901).—Très voisin de notre *phlaeas*, mais plus petit, avec les points plus marquées, les aîles plus arrondies; le dessous des ailes inférieures d'un cendré-blanchâtre, avec la bande fauve marginale bien marquée. Nord de la Californie. Il se retrouve dans tout le nord des Etats-Unis (Boisduval). Imago.—Forewings brilliant orange-red, with a metallic coppery lustre; near the base, especially on the lower half, a very little darker; the median veins in the ♂ dark brown; the costal border, as far as the subcostal nervure (excepting the extreme base), the outer border, for the width of at least the interspace, more broadly above, and the apical half of the inner border, dark grey-brown with a slight greenish tinge; in the ♀, the costal border is only marked in this way very narrowly on its apical half, the basal half being either greenish-grey, or like the prevailing colour of the wing, but with a decided greenish hue. The wing is ornamented by eight straight, quadrate, transverse, very dark mulberry-brown or black bars, each crossing an interspace; two are in the cell and the others form an irregular, transverse, series, in the middle of the outer half of the wing; one is near the middle of the cell, just over the first divarication of the median, but does not reach either margin of the cell; another borders on

both sides, the extremity of the cell; three others, the first of the transverse series, are found respectively in the two lower subcostal and the subcosto-median interspaces (and occasionally a fourth, small and obscure, in the next interspace above) forming a curving row, the interior edge of the lower one being midway between the extremity of the cell and the outer margin, and the upper spot removed inward from it by its own width; one, in the upper median interspace, is removed inward by twice its width from the one above it; and that in the lower median interspace by half its own width outward; the lowermost, in the medio-submedian interspace, is removed inward from the one above it by twice its width, and its exterior edge is at twice an interspace's width from the outer border; the spot at the extremity of the cell is broader than the others, sometimes equalled by the lowermost; basal half of the fringe like the outer border; apical half pallid or whitish. Hindwings dark grey-brown, scarcely with a greenish tinge, the central portion of the basal third of the wing with more or fewer scattered, greenish-coppery, scales, the inner half with numerous grey-brown hairs; outer border edged delicately with dark brown, followed by a broad band of orange-red, broader than an interspace, extending from the inner border to the middle of the upper subcostal interspace, interrupted in the middle of each interspace by a small, round, blackish spot, occupying the exterior border of the band, or causing it to be sharply crenulate; next the slightly sinuous interior edge, in the middle of each interspace, is a faint, vague, roundish spot, slightly deeper in tint than the prevailing colour, often scarcely discernible, capped by a cluster of perhaps half-a-dozen pale blue scales, and these again by another indistinct dark spot; the extremity of the cell is marked by a narrow, blackish stripe; fringe as in the forewings, the pale exterior half interrupted with brownish at the tip of the lower median and submedian nervules. ♂ GENITALIA.—The ♂ appendages with the bent elongated lateral alations compressed, cylindrical, equal throughout, rounded at tip, and somewhat swollen anterior to it, the distal half bent abruptly downward, and somewhat outward; lateral arms tapering regularly to a fine point, sickle-shaped, the curve nearly equal throughout. Clasps forming a tumid subequal lamina three to four times as long as broad, broadest beyond the middle, the apical third curving a little inward, roundly truncate at tip, the upper posterior corner roundly angulate and slightly produced. SEXUAL VARIATION.—

| MEASUREMENTS IN MILLIMETRES. | MALES (27). | | | FEMALES (17). | | |
|---|---|---|---|---|---|---|
| | Smallest | Average | Largest | Smallest | Average | Largest |
| Length of forewings | 12 | 13·25 | 14·5 | 13·25 | 14 | 15 |
| Length of antennæ | 6·6 | 7·3 | 8 | 6·75 | 7·25 | 8 |
| Length of hind tibiæ and tarsi | 3·8 | 4 | 4·25 | 4 | 4·25 | |
| Length of fore tibiæ and tarsi | 2.75 | 3 | 3·1 | 3 | 3·4 | 3·5 |

VARIATION.—(1) Ab. *fasciata*, Streck., "Cat. Amer. Macro-Lep.," p. 101 (1878).—In the row of spots in the middle of the outer half of the wing, each spot, though perfectly distinct from the others, is expanded a very little exteriorly, and very much interiorly; the spots beyond the cell joining that which borders the outer limits of the same; those in the median interspaces extending nearly, or quite, to the base of the interspaces, and that of the medio-submedian interspace is, in one instance, as long as broad, and in the other twice as long as broad, instead of being, as normally, half as long as broad. On the undersurface, the wings have the normal pattern, etc. (2) Ab. *obliterata*, Scudd., "Butts. New Engl.," ii., p. 1001 (1889).—In this there is a partial and nearly complete obliteration of the extra-mesial spots of the front wing, both above and below. One such specimen is figured by Maynard (*Butts. New. Engl.*, v., fig. 52*a*) with no spots at all. Curiously, the most persistent of all the spots, whether above or below, is the upper of the two beyond the cell, which is sometimes reduced to the merest dot of black (below, encircled with white). The two cellular spots remain unchanged, etc. (3) Ab. *fulliolus*, Hulst, "Ent. Amer.," ii., p. 182 (1886).—In this the coppery-red is replaced by an equally glowing, somewhat sooty, yellow. [Scudder suggests that it corresponds in *hypophlaeas* with the ab. *schmidtii* of *phlaeas*.] (4) An aberration (*Bull. Brooklyn Ent. Soc.*, ii., p. 8) with the undersurface of the hindwing on the right side marked by red dashes, running from base to exterior margin (*teste* Scudder). EGG.—Cells subcircular, but angulated, the largest about ·19mm. in diameter, the smaller about ·1mm., excepting next the base, where they are only ·045mm. broad;

they are bounded by distinct, heavy, greatly elevated walls, thickened at the junction of several cells; the surface within the cells is shallowly concave, and marked by delicate, excessively tortuous, lines, covering the whole area, and giving it the appearance of frosted glass. Micropyle rosette ·12mm. in diameter, made up of little lenticular cells, about ·01mm. in diameter. Colour very delicate pale green, the walls of the cells white or hoary. Height ·29mm., breadth ·62mm. Compared with the egg of *phlaeas*, the egg of *hypophlaeas* agrees entirely in size and proportions with that of *phlaeas*, but the surface is more rugose, the rugosities more connected in tortuous lines, and are also slightly more pronounced in *hypophlaeas* than in *phlaeas*, besides which, the cells in our species are slightly smaller, and consequently more numerous. In making its exit, the larva eats only the summit of the egg, where the pits are small and separated by thin walls. Oviposition.—When laying her eggs the female flies to a plant of sorrel, remains nearly or quite still, often for two minutes or more, and then walks down the plant, moving this side and that, in search for a suitable spot, until finally, turning entirely around and curving the body downward, she deposits a single egg; this occupies about three seconds, and then she crawls back and at once takes flight. The eggs are usually laid near the base of the leaf on the rounded surface, but sometimes on the leaf itself, indifferently above or below, and occasionally on the stem; many eggs may be laid on a single plant, but I have never found more than one on a leaf in free nature. Five females confined in June, over sorrel, laid 120 eggs, of which 51 were laid on the upper surface, 45 on the under surface, 8 on the edge of the leaves, and 16 on the stems. They hatch in from 6½ to 10 days, according to the season. Foodplants and Habits of Larva.—The caterpillar appears only to feed on the common sorrel (*Rumex acetosella*, Linn.), although several persons, apparently quoting Harris, say that it devours also the dock (*Rumex crispus*, Linn.), and other species of the genus. Harris, however, merely suggests that it may do so. The European *phlaeas* is also said to feed both on dock and sorrel, although recently Prittwitz has affirmed that it devours only the latter (*Rumex acetosa*). Mr. Lintner informs me that our insect will feed on clover. Larva.—*First stage:* Head pale testaceous, the sutures of the triangle blackish-fuscous; ocelli blackish-fuscous; edge of labrum and mouthparts tinged with ferruginous, body pale yellowish-green, with a dark brownish spot on the top of terminal segment; warts both simple and hair-bearing, blackish-fuscous, those of the latero-stigmatal series with a pale centre; hairs pale brownish; stigmata testaceous; legs greenish-yellow; claws fuscous; prolegs yellowish. Length 1·12mm., width ·26mm.; length of superior longest hairs ·5mm., of superior shorter hairs ·14mm., of lateral hairs ·17mm.; width of head ·25mm. *Second stage:* In this stage the whole aspect of the creature has changed on a minute inspection. The form becomes less exaggerated in its distinctions between front and hind end, the body is broadest at the second thoracic segment, and, instead of the single series of excessively long, spiculiferous hairs, there are now a multitude of series with spiculiferous hairs, but the hairs are not nearly so curving nor so long, and all are of the same length; there are about 25 hairs to a segment; besides these the crateriform warts have increased in number, are lower down than before, not all in one row, several on a segment of unequal size, and varying from segment to segment, and even apparently at the two sides of the body. The skin is delicately shagreened, and the body is of a pale, pellucid brown colour. Spiracles black rimmed. Length, 2·2mm., breadth ·5mm., *Third stage:* Head blackish-castaneous, antennæ pale. Body, above and below, delicate grass-green, slightly darker along the middle of the sides; a faint, dusky, dorsal line. Hairs brownish-fuscous, curving backward a little. Spiracles luteo-fuscous. Legs slightly infuscated. tipped with fuscous; prolegs of the colour of the undersurface. Length 3·5mm., breadth 1mm., height ·8mm. *Fourth stage:* Head pale yellowish-green, edged below, including the bottom of the ocellar field, with blackish-fuscous, the suture of the triangle marked with fuscous; labrum rimmed with whitish; mandibles reddish-fuscous. Body as previously described; in some instances a dorsal stripe, and a broad, ventro-stigmatal band around the whole body; dull roseate, the colour apparently confined to the hairs. Length, soon after moulting, 5mm., breadth 1·75mm., height 1·35mm. *Last stage:* Resembling the former altogether, excepting that all the specimens with roseate stripe and margin, which I have reared, become wholly green after the last moult. Length 14·5mm., breadth 4·25mm. Just before pupation the fungiform appendages of the coming pupa appear as white hemispherical papillæ, dotting the surface of the caterpillar. Pupa.—The general colour is light brown or livid, tinged

with very pale yellowish-green. The thorax is darker and tinged with ferruginous, dotted and spotted with blackish-fuscous, a subdorsal pair at the highest point of the mesothorax. There is a rather broad, blackish-fuscous, dorsal streak on the mesothorax, and, on either side a similar dark band follows the hinder edge of the mesonotum, and reaches the base of the wing; the dorsal region of the abdomen is infuscated. The lower surface is paler; the eyes are reddish-brown; and the interspaces of the wings are mostly filled with blackish-brown streaks, darkest toward the upper border. On the abdomen are many rows of roundish black dots, arranged in longitudinal series, as follows: A faint dorsal row placed centrally; a faint subdorsal series placed posteriorly; a laterodorsal series placed anteriorly; a lateral series placed anteriorly; close to it a laterostigmatal series placed posteriorly; a stigmatal series placed posteriorly, further back than the other posterior dots, and composed of two confluent dots; an infrastigmatal series placed posteriorly, and on the posterior segments, having a companion on the anterior part of the segment; a lateroventral series placed centrally, and a double subventral row. Raised lines covering the body, russet; the short fine hairs reddish or blackish; the lower equal portion of the pedicels of the fungiform papillæ blackish-fuscous, the discs colourless. The warts on which the papillæ are mounted are ·0127mm. in diameter, the pedicel half that diameter, and the equal portion 0·47mm. long; the expanded portion is ·025mm. long, and the disk ·055mm. in diameter. Length 9·5mm., height 3·5mm., breadth at thorax 3·25mm., breadth at abdomen 4·25mm. Enemies.—This insect is subject to at least two hymenopterous parasites. Expecting that so common a species would have its enemies, I collected a large number of eggs, laid naturally, at Norwich, Conn., in June, but only one of them had been attacked. The little parasite, *Telenomus graptae*, ate its way through the bottom of one of the cells on the side, on June 23rd. Another parasite is *Ichneumon versabilis*, a much larger insect, which attacks the larva and emerges from the chrysalis; one came out fifteen days after pupation. Gentry asserts that it is also destroyed by the wood pewee (*Contopus virens*) and the night-kawk (*Chordeiles virginianus*), as he has taken large numbers both of the larva and imago from their stomachs. Time of appearance.—It is double-brooded in the northern, triple-brooded in the southern, parts of its range, changing in New England at about 43° 15′ N. lat., but with some variation, or not far north of the dividing line between the Canadian and Alleghanian faunas; throughout Maine, at least as far south as Brunswick, in the White Mountain region of New Hampshire, and probably in Williamstown, Mass., it is double-brooded; it is triple-brooded throughout Massachusetts (excepting perhaps in parts of Berkshire) including the elevated towns of Andover and Princetown, as well as in Albany, N.Y., and Walpole, N.H. We may perhaps add to this list Milford and Dublin, N.H. and Sudbury, Vt., although in the first two localities, at least, the appearance of the broods is somewhat later than in Massachusetts, the dates agreeing better with those Saunders has furnished for Ontario, where he believes it to be only double-brooded. In the southern, or triple-brooded districts, the insect makes its first appearance from May 10th-23rd, according to the season. [Dr. Harris raised one specimen from chrysalis on May 1st, but this was probably under artificial conditions. He, however, reports one capture as early as March 15th, and Dr. Packard another in Brunswick, Me., April 3rd, both of which seem to be altogether exceptional, and the result of unusually warm weather acting upon chrysalids in very favourable stations.] It becomes common in about a week, and continues until about the end of the third week of June. The eggs are laid during June, and, in advanced seasons, during the latter part of May; after six or seven days, or if very early, as much as ten days, these hatch; the larvæ become fullgrown during the latter part of June and early July, and, after about ten days spent in the chrysalis, evolve a new brood of butterflies. This first appears between July 5th and 10th, becomes abundant by the 19th or 20th, and continues until after the middle of August, sometimes until almost the end of the month. The eggs are probably laid during the last week of July, and the first half of August, as pairing is then common; the earliest caterpillars become fullgrown toward the middle of August, while the chrysalids continue for a longer period than in July, sometimes for 19 days. The third generation of butterflies is much the most abundant, and appears in the latter part of August, generally by the 26th, but, sometimes, not until the early days of September; the butterflies continue to emerge from the chrysalis until the middle of September, when the brood is most abundant, but it has generally entirely disappeared by the close of the month. The eggs of

this brood are deposited in September, are hatched in eight days. and the larva probably changes to chrysalis before winter. Some of my larvæ, however, did not reach their last stage until October, and such may possibly hybernate in this condition, or, as Sprague believed, perish altogether. Where the butterfly is double-brooded the first generation does not make its appearance until June, usually between the 4th and 10th, though a few specimens may occasionally be seen in favourable seasons late in May; it becomes common by the 19th or 20th, and lasts until nearly the middle of July; in the extreme north, however, as at Quebec and Cacouna, it does not seem to appear before the last of June, and probably continues throughout July. The period of the earlier stages is undetermined, excepting that the chrysalis generally lives about twelve days, but the second brood of butterflies is first seen between August 6th and 12th, and continues to emerge until the close of the month, and flies until the end of the third week of September; the eggs are probably laid late in August and early in September, giving the larva ample time to attain its growth and change to chrysalis before winter; the chrysalis is found hanging upon the under surface of stones. HABITS AND FLIGHT.—The butterfly alights on stones and twigs and suns itself, or flits away among the clover-heads. It never flies long distances, nor rises more than a foot or two above the ground, but flutters rapidly from side to side, with a peculiar motion; after each flutter the wings are apparently closed an instant, for during flight their under surface is distinctly visible. It is very pugnacious, attacking, and pursuing, larger butterflies, and even assaulting the monster Carolina locust (*Dissosteira carolina*) in its short and heavy flight. When two of the *Heodes* meet, they circle rapidly and coquettishly about each other, always keeping near the ground. In keeping with its activity is the fact that it is one of the first butterflies to appear after sunrise, and one of the latest to disappear at nightfall. It is on its unceasing rounds the livelong day. Gosse, in writing of this insect, says (*Can. Nat.*, p. 219) it would be, perhaps, the most splendid butterfly we have if its size corresponded with its beauty. The richness of the glowing, flame-coloured wings is worthy of admiration, and the under surface is very delicate, and I do not see that it is less beautiful because it is diminutive, though, if it were as large as a Swallow-tail or a Camberwell Beauty, it would strike the attention more readily. It is curious to watch their proceedings at pairing-time, which remind one strongly of the English sparrows. One may be seen perched on a leaf, its hindwings quite still and horizontal, while the front pair are slightly raised and in a constant flutter. Its follower will be close behind it, apparently unconcerned, but as it walks after the leader, the latter walks off a little further; the little play will proceed a while when the leader flies away, quickly followed by the other. Which sex takes the lead in this performance I have not determined. POSTURES AND SLEEP.—These butterflies are very fond of resting on bare spots fully exposed to the sun; wherever they alight, even if on a twig, they at once turn around so as to bring their backs to the sun, and open their wings at right angles, the forewings partially concealed by the hind pair; the antennæ diverging at an angle of from 95°-100°. When resting in the shade, the wings are closely appressed, the forewings concealed by the hind pair, so that the costal edges are brought together; the antennæ viewed from above, are perfectly straight, and spread at an angle of 85°, their tips being about 11mm. apart; when viewed from the side they are slightly curved downward, but otherwise are straight and nearly continuous with the body. When walking, even on a perpendicular surface, the tip of the abdomen is trailed on the ground and the forelegs are used like the others. When they emerge from the chrysalis they at once seek a vertical surface to expand their wings, which then hang, when fully expanded, so that the costal edges of all the wings are together, and the inner edges of the hindwings just touch the surface of rest; the antennæ are then held quite horizontally (or later are slightly raised), and are scarcely parted, the clubs often in actual contact. Miss Caroline G. Soule, observing this butterfly clinging, toward sunset, to grass blades with drooping wings, made some experiments to see how soundly it slept (*Psyche*, v., p. 42). She says: "Approaching one, I gently touched the grass, but the butterfly remained as before, I shook the grass, then shook it less gently, but the butterfly did not stir. Then I picked the blade and carried it in my hand, not taking any care to keep it upright, for five blocks (in the city), and even then it was only as the sun struck the grass, when I crossed the street, that the butterfly awoke, and lazily flew to a shady place, resting as before. I followed, and this time a touch was enough to startle it. I did not arouse it a third time, but afterwards, in the country, I tried the same experiment several times, always with the same result. I have always

found the butterfly in the same position, more than half way up the grass blade, in the shade, and with the head up, the wings drooped to an acute, instead of a right, angle with the body. It certainly sleeps very soundly, and, when aroused, does not become so active as in the middle of the day. I have waked and disturbed one six times, each time immediately after it had settled down after a former awakening, and, even the last time, it flew but ten steps or so, and settled down as before. I once counted 7 perched for the night on grass-blades within an area of four square feet. I have generally found them on buffalo or herd's grass, about half way down the stalk, but with the head downward, the costal edges of both wings together, the abdomen bent back to an angle of 135° with the thorax, the antennæ straight forward, parted at an angle of about 15°. Distribution.—This member of the Alleghanian fauna is widespread, invading the southern portions of the Canadian fauna and extending to the Pacific coast; its very abundance has prevented its specification in many places, so that our knowledge of its southern limit is not very definite. It is, however, usually common in Maryland (Uhler) and is even painted by Abbott with the memorandum "met with by Elliot on his tour to the mountains" *i.e.*, the Alleghanies of Georgia; although it occurs in California, and is stated by Saunders to be found in Canada from the Atlantic to the Pacific, it has not been traced across the continent, but only indicated at one or two points west of the Mississippi, such as Oxley Ranche, between Fort Macleod and Calgary (Geddes), and Iowa (Chic. Mus.); the westernmost points east of this in which it has been obtained are Racine, "common" (Hoy) and Beloit, Wisc. (Chamberlin); it is, however, abundant enough in northern Illinois (Worthington); Michigan (Mich. Univ. Mus., Harrington), and at Sault St. Marie (Bethune), and evidently must be connected with California through more northern latitudes. Eastward it occurs in Nova Scotia (Brit. Mus., Jones) and Cape Breton (Thaxter), and, in the north, has been taken at Cacouna (Saunders), Quebec (Bowles), Montreal, generally common (Caulfield), River Rouge District (D'Urban), and Ottawa (Billings, Fletcher), and has even been taken at Moose Factory, James Bay (Weir). Of late years specimens that have been credited to this species have been reported as taken in Norway. It is found throughout New England almost as abundantly in the White Mountain district as elsewhere, and is one of our commonest species. Haunts.—It is found most commonly in dry, sandy or gravelly, barren spots, favourable to the growth of sorrel, and is particularly common by the sides of paths in dry pastures or upland highways. It constantly invades the town, and, a fire itself, seems to delight in finding the hottest places for its gambols. Near Quebec, Mr. Bowles finds it "in rocky places where there are mossy spots."

Whether this life-history will prove sufficiently convincing to all lepidopterists that the American *hypophlaeas* is merely a variety of our *Rumicia phlaeas*, or a distinct species, we do not know. For ourselves, we are satisfied that it is no more than a local race, and has no clearly marked structural specific characters. Schöyen, Schneider, and other Scandinavian lepidopterists have no hesitation in referring their Arctic form to *americanus*, to which, also, Staudinger refers the insect from Amurland—Sutschan.

β. ab. *fulliolus*, Hulst, "Ent. Amer.," ii., p. 182 (1886). *Fulliola*, Scudd., "Butts. New Engl.," p. 1002 (1889).—*C. americanus* var. *fulliolus*, nov. var. A variety of this common species in which the coppery-red is replaced by an equally glowing somewhat sooty-yellow (Hulst).

Scudder observes that, in this form, "the coppery-red is replaced by an equally glowing, somewhat sooty, yellow," and suggests that it corresponds in the American *hypophlaeas*, with the ab. *schmidtii* of *phlaeas*, although it appears to us to be much nearer our ab. *intermedia*, of which it would appear to be simply a suffused form. Scudder further notes that "it is, perhaps, not different from a specimen captured at Ellsworth, Maine, in 1886, by Mr. Carl Braun, in tolerably fresh condition, which is remarkable for having the fiery-red of the upper surface uniformly bleached to a pale but glistening saffron; a faded trace of the original brilliant colour is found only on the griseous costal margin of the front wings and at the anal angle of the hind-wings."

γ. var. *feildeni*, McLach., "Jn. Linn. Soc.," xiv., p. 111 (1878); Dyar, "List Nth. Amer. Lep.," p. 41 (1903).—28mm.-29mm.; differs from typical *phlaeas* (and also from *americanus*) in the brilliant copper colour of the anterior wings being much less fiery and more subdued and with brassy reflections (especially in the ♂), so that the colour might almost be termed brassy rather than coppery; the spots, normal in number and position, but smaller; the dark border narrow and silky greyish-black with grey fringe, the dark costal margin scarcely indicated; on the posterior wings, the ground is of the same silky greyish-black as in the border of the anterior, the pale submarginal band pale orange, with occasionally the faintest indications of bluish spots above it. Beneath, the anterior wings are greyish-orange (with the ordinary spots), the border and the posterior wings pale cinereous; on the latter wings, the dark dots are very faintly indicated, and there is also only the faintest indication of the red submarginal band. Three examples (two ♂, one ♀) from lat. 81° 45′ (McLachlan).

McLachlan adds that he was at first inclined to place this very distinct variety as a form of *americanus*, but the posterior wings are more tailed than in any examples he had seen of that species, although scarcely so much so as in ordinary *phlaeas*. The common origin, he says, of both species can scarcely be doubted. No species of *Rumex* was found in these high latitudes, but *Oxyria reniformis* occurred at all the stations, and in all probability serves as the foodplant.

### The central and eastern Asiatic forms.

The variation of the eastern forms combines that of the north and south of Europe, often in a greatly enhanced and very extreme manner. This variation has already been referred to (*anteà*, p. 332) where we quote Weismann's remarks on the eastern examples in his collection. Speaking of examples taken in Séhol, in Tartary, Lucas says: "They are larger than those found in Europe, for their expanse is about 32mm., further, the shining coppery-tawny of the forewings above is often very bright and inclined to reddish; the black spots, which are also very large, have their edges of a yellowish-white. The blackish-brown of the hindwings above is very deep, whilst beneath, these same wings are of a clear ashy, with the spots more strikingly developed, larger, and of a deeper black; one also notes that all these spots are surrounded by an edging of a paler ashy than the ground colour of the wings; the wavy "briquetée" line, corresponding with the tawny band of the upperside, is much wider than in European specimens, more strongly developed, and of a bright reddish-tawny." Baker notes (*in litt.*) that two specimens in his possession from Turkestan are "the largest he has seen, both bright, but the ♂ slightly suffused; the hindwings with broad red bands and with a row of blue spots; beneath, the hindwings are very pale ochreous-grey, with small distinct black points." Pryer, in his remarks on this species in Japan, says (*Rhop. Nihonica*, p. 16) that it "varies greatly in size and coloration, according to the time of year that it emerges in the imaginal state, early spring forms being small and brightly coloured, often with a row of blue spots towards the outer margin of the hindwing, but, as the temperature increases, the examples become larger and darker, until they reach a size nearly twice that of English specimens. During the hot months, the ♂ s are often quite black, and this continues until the last brood in November. A difference of 20 miles is, however, sufficient to account for small light coloured ♂ s occurring in one locality, and black ♂ s in another, *e.g.*, some years ago, in November, I collected the small light coloured ♂ s

in the neighbourhood of Yokohama, and the next day took black ♂s in Boshin, not more than 20 miles from Yokohama, whilst, by working from Boshin, towards the north, through Kadzusa, I found the dark form to be less abundant, until at Kanosan, they were entirely replaced by the pale form." Kaye observes (*Proc. Sth. Lond. Ent. Soc.*, 1900, pp. 89-90) that "the spring broods of *phlaeas* in Japan and Britain are practically indistinguishable on the upperside, but, on the underside of the forewings of the Japanese specimens, the white rings round the spots are most pronounced, and the blotches on the hindmargins are five or six in number, instead of three, as in the British examples; on the underside of the hindwings the ground colour is of a silvery-brown, and the black spots edged with white are more pronounced; the colour of the red band, too, is much more vivid. . . . . In the black summer form the red band is much widened and very brilliant." Leech simply notes that, in Japan, "it is an extremely variable species, both in size, colour, and markings; during the summer the typical form gives way entirely to var. *eleus*, a few intermediate forms occur, the specimens darker in some localities than in others; the largest and darkest I found at Nagasaki, in July" (*Proc. Zool. Soc. Lond.*, 1887, p. 414). Later, he records (*Butts. of China*, ii., p. 399) the insect as common throughout Japan and Corea; and adds that he "met with the large bright form, var. *chinensis*, Feld., at Ningpo, and received the same form from Kiukiang, together with the dark (*eleus*) form. The species was not met with in western China." At Wei-hai-wei, T. B. Fletcher observes that the insect is triple-brooded, and that "the specimens vary much according to the time of year. Many examples are large, and comparatively light coloured, and could hardly be separated from large British specimens. Those taken in the spring (April) are much more typical (*i.e.*, the copper colour is paler) than the generality of Asiatic specimens; those taken in June are small and much suffused with black, whilst those captured in September are large and dark." He says that they are all referable to var. *chinensis*, Feld., and the two later broods fall under var. *eleus*, Fb., and that he has seen none so black as those he had taken in Japan (summer brood), in which the copper is almost wholly concealed by black scales (*Ent.*, xxxiv., p. 156). He further adds that, "at Chifu, the spring specimens are quite typical, but that summer and autumn examples are darker, and fall under the head of var. *eleus*, although they are not nearly so dark as some of the Japanese summer brood." The following are the described Asiatic forms:

α. var. *turanica*, Rühl, "Pal. Gross.-Schmett.," p. 747 (1896); Tutt, "Brit. Butts.," p. 153 (1896).—An intermediate race between the typical form and var. *eleus*; the upperside only slightly darkened; the underside very pale. Tura (Rühl).

From Rühl's description, one would conclude that this was a local race, and not an aberration, differing, not only in the tint of the upper-surface, but also in the character of the underside.

β. var. *oxiana*, Grum-Grsh., "Rom. Mém.," iv., p. 365 (1890); Rühl, "Pal. Gross-Schmett.," p. 747 (1895); Tutt, "Brit. Butts.," p. 153 (1896).—In the month of May, *phlaeas* is found everywhere in the Pamirs, but not beyond 4000ft. In the month of August, the second generation is on the wing, this, however, cannot be referred to *eleus*, because, although "supra nigricans," it is not "caudata." Besides, as far as I recollect, it is a transition to the form of *phlaeas* from Bokhará, which I describe as *oxiana*, Gr.-Gr., and which differs from the type (1) by the very dark coloration of the wings of the ♂s above; (2) by the very pale coloration

of the whole undersurface of the hindwings. Kabadian in mid-May (Grum-Grshimailo).

Rühl notes the ♂ as "very dark above, the underside of hindwings very pale, not tailed."

γ. var. *comedarum*, Grum-Grsh., "Rom. Mém.," iv., p. 365 (1890); Rühl, "Pal. Gross-Schmett.," p. 747 (1896); Tutt, "Brit. Butts.," p. 154 (1896).—The form which I have reported from the southeast of the Kounjout mountains, approaches the var. *oxiana* very closely. Unfortunately I have only a single ♀, on which it is difficult to establish a new variety. Its distinctive characters are: (1) The largest example of *phlaeas* in my collection is 31mm., whilst the form which I here describe is 36mm. (2) The coloration above is very pale. (3) The coloration of the underside is paler than in *oxiana*, all the spots are very large and particularly strongly developed on the hindwings. In case this form should be found constant, I propose to call it *comedarum*. Taken on the Col Beïk, at 14000ft. elevation, in mid-July (Grum-Grshimailo).

δ. var. *chinensis*, Feld., "Verh. Zool.-Bot. Ges. Wien.," xii., p. 488 (1862); Leech, "Butts. of China," ii., p. 399 (1893-4); Fletcher, "Entom.," xxiv., p. 156 (1891); Rühl, "Pal. Gross-Schmett.," pp. 218, 747 (1896).—From Shanghai. This differs from European and western Asiatic examples by its greater size; much larger spots on the forewings; narrower marginal band on the upperside of the hindwings; large conspicuous spots on the underside. Described from a single ♀ (Felder).

Leech says (*Butts. of China*, ii., p. 399) that this insect differs from typical specimens in its larger size, much broader spots of the forewings, narrower marginal band on the upperside of the hindwings, and larger, more distinct spots on the underside. He adds that he met with this form in the Snowy Valley at Ningpo, the specimens being much larger than any others in his collection; he also received the same form from Kiukiang, together with the dark (*eleus*) form. See also Fletcher's remarks (*anteà*, p. 349).

## The Indian forms.

Nicéville says (*Butts. of India*, p. 317): "There is no doubt that the local races of this species (in India) are the immediate effect of the different climates in which they live; the darkest form, *timeus*, occurs where the rainfall is heaviest, and the vegetation consequently most luxuriant, *stygianus* and *baralacha* inhabiting far more barren and rainless regions. It is also certain that an absolutely complete gradation of forms between all the Indian races, at any rate, could be shown, were sufficient material available, but this does not prevent the local races being distinct and capable of discrimination at their respective headquarters." The following are the original descriptions, etc., of the Indian forms:

α. var. *timeus*, Cram., "Pap. Ex.," ii., p. 137, pl. clxxxvi., figs. E, F (1777); Moore, "Proc. Zool. Soc. Lond.," 1865, p. 506 (1865); Butl., "Proc. Zool. Soc. Lond.," 1886, p. 368 (1886); Nicév., "Butts. India," iii., p. 315, pl. xxvii., fig. 205 (1890). *Timaeus*, Doh., "Journ. As. Soc. Beng.," lv., pt. 2, p. 130 (1886).—The red colour on the upperside of the wings, and the dirty-yellow ground colour of the underside of the forewings, are shining, exactly as that of *P. virgaureae* and *P. phlaeas*. there being much resemblance between the last-named and that we figure. It belongs, like the others, to the "Argus" group (*Papilio Plebeius Ruralis*). It was taken in Smyrna (Cramer).

It is remarkable that this name was first given to an aberrational form occurring in Smyrna, which becomes racial in India. The figures of Cramer must be consulted, as well as his description, to get an idea of the form described. Cramer's figures are crude, but the forewings are deeply suffused along the inner margin, the suffusion extending up to, and largely including, the discal spots; the costal and

outer margins broad; the copper, therefore, runs as a longitudinal band through the discal area to outer marginal band, extending beyond the discal cell downwards between the submarginal row of spots and outer band. The hindwings have a characteristic red marginal band, with a row of four bright blue spots and long tails. The underside of the forewings orange-red, with the black spots surrounded by white; of the hindwings deep grey-brown, with a wide red-brown marginal band and a fine red antemarginal line, the spots practically nil, a fine transverse line between the middle of wing and the marginal band. Nicéville observes (*Butts. of India*, iii., pp. 315-6) that Cramer described this form from Smyrna, in Asia Minor; that there are numerous specimens of it from Persia in the Indian Museum, Calcutta, and that it occurs from Kashmir to Naini Tal, at any rate at suitable elevations on the outer ranges of the Himalayas. He describes it as follows: "♂, ♀, 1·3ins.-1·7ins. ♂, larger than the typical form; upperside of forewing very much darker, the coppery colour almost entirely overlaid with blackish; the black spots larger; otherwise as in the typical form. ♀, larger; upperside of forewing with the lower basal area thickly overlaid with blackish scales, having the apical and outer portions alone of the coppery ground colour quite clear. Hindwing with the discal blue spots often very large and prominent, otherwise as in the typical form." He also says that Colonel Lang notes that "this species has a wide distribution in the northwest Himalayas; common in the outward ranges, Kasauli, etc., appearing here and there up to Upper Kunawar, in very various climates. It, however, disappears in certain gaps, as it were, which are occupied by *C. pavana*." Butler notes that Major Yerbury found it common at Murree, and along the hills in Thundiani in August and September, and adds that "*timeus* appears to be a tolerably constant form, resembling, on the upperside, *stygianus* from Kandahar, but from this, the darker colour and red band on the underside of the hindwing at once separate it." Butler records also *timeus* from Kandahar; Lang reports it as common at Naini Tal at 5500ft. to 7000ft., and Doherty remarks of Kumaon specimens that, "comparing the prehensores of my specimens of *timeus* with those figured by Dr. White, I should suppose the species distinct from the European *phlaeas;*" he also met with it at Naini Tal at between 6000ft. and 7000ft. above Garbyan, and at Kalapani, northeast Kumaon, from 11000ft.-15000ft.

β. var. *stygianus*, Butl., "Proc. Zool. Soc. Lond.," p. 408, pl. xxxix., fig. 5 (1880); "Ann. Mag. Nat. Hist.," 5th ser., ix., p. 208 (1882); Nicév., "Butts. of India," iii., p. 316 (1890).—♂, smoky-brown; the primaries in certain lights shot with fiery copper; spotted with black as in *C. timeus* (*? eleus*, Fabr.); two small orange spots beyond the interrupted black discal series; the hindwings with a slender, undulated, deep, reddish-orange band on a black ground near the outer margin; above it a series of four or five pale blue hastate spots, and above these again, beyond the end of the cell, two black dots; a black dash at the end of the cell; fringes greyish-white; body blackish. Wings below, very like *C. timeus*, but considerably paler, the submarginal black spots of primaries less distinctly white-bordered; the apex and outer margin of primaries, and the ground colour of the secondaries, very pale grey. Expanse of wings 1in. 4lin. The ♀ larger than the ♂; the primaries, with the outer third of the cell, and the subapical area, bright orange; the black spots larger, otherwise similar; below slightly yellower in tint all over, so that the ground colour of the secondaries has a pale brownish, rather than greyish, hue; expanse of wings, 1in. 5lin. Common in April and May, abundant in June. This insect is considerably larger than *C. phlaeas*, and has the costal margin of the primaries longer (Butler).

In 1882, Butler observed that "an examination of 41 examples obtained at Kandahar, in October, has shown that the form cannot be specifically separated from *C. phlaeas*. Leech observes (*Butts. of China*, ii., p. 399) that *stygianus*, Butl., as well as *timeus*, Cram., are both referable to the form of *phlaeas* known in Europe as var. *eleus*, Fab. Besides other details, *stygianus* is not "tailed," and has a row of blue spots bordering the orange outer-marginal band of the hindwing, the former being a marked character of *eleus*, the latter not noticed in that form. Swinhoe also notes (*Trans. Ent. Soc. Lond.*, 1885, p. 340) that, "with a long series, containing the typical forms of *phlaeas*, Linn., *timeus*, Cram., and *stygianus*, Butl., it is absolutely impossible to separate them. Quetta, September; Kandahar, October to January." Nicéville, however, writes (*Butts. of India*, p. 316): "In the Indian Museum, Calcutta, are a pair of this species, taken by me at Darcha, in Lahoul, in July, 1879. Roberts found it common at Kandahar in April and May, abundant in June. In my collection are many specimens of both sexes—from Quetta (September) and Kandahar (October and November), taken by Swinhoe; from Bushire, in Persia, taken in April; from Astor, 7700ft., taken in September by Biddulph, and from Pangi, taken by Ellis, in October. All these examples are larger than typical *phlaeas*, the ♂ on the upperside of the forewing darker, and the underside of both wings paler. They are smaller than the local form *timeus*, the ♂ on the upperside of the forewing brighter, in the ♀ bright orange rather than coppery. If the local races of *phlaeas* are to be discriminated by separate names, *stygianus* appears to me to deserve to be so separated, as much as *timeus* or *baralacha*, though the describer himself has failed to find characters of sufficient specific value to enable him to keep it distinct from *phlaeas*."

γ. var. *baralacha*, Moore, "Journ. As. Soc. Beng.," liii., pt. 2, p. 25 (1884); Nicéville, "Butts. of India," iii., p. 317 (1890).—Expanse, 1·37ins. ♀. Differs from specimens of the same sex of *phlaeas* var. *stygianus*, Butl., taken in the neighbouring country of Lahoul. Upperside of forewing golden-yellow, with a blackish quadrate spot in the middle of the cell, a larger spot at its end; three oblique subapical spots, and three lower discal spots, the lowest spot being the longest and curved; from the three subapical spots, some black speckles proceed to the discocellular spot; the costal edge is very narrowly bordered with brown, and the exterior margin has a narrow macular brown border of half the width of that of the above-mentioned species. Hindwing golden greyish-brown, with a broad, pale red, outer marginal band, which is very slightly indented with black at the end of the veins on its outer border, and, on the inner border, by a row of indistinct blackish spots surmounted by blue-grey scales, above which is a discal row of five or six smaller black spots, and also a black lunule at the end of the cell. The underside of similar colour to that of the above species; forewing with the spots as on the upperside, but pale bordered, also a spot at the base of the cell, two small spots on the costa above the discal series, and three linear spots on the exterior margin above the angle, these latter spots being nearer the margin, hindwing with less defined, red-streaked, marginal band, the discal and other spots also comparatively larger. Baralacha Pass, 16060ft., Ladak, taken July, 1879, by de Nicéville (Moore).

Nicéville observes (*Butts. of India*, iii., p. 317) that "the type (and only known specimen) of this local race is in the Indian Museum, Calcutta, it is of large size, true expanse 1·5ins. (*i.e.*, measured from apex of forewing to centre of thorax and doubling the amount); coloration a little paler than in the same sex of *stygianus*, the black spots on the upperside of the forewing larger, and the costal and outer borders narrower."

### African forms.

The species is common throughout northern Africa, where its different forms of variation are essentially the same as those of southern Europe, and must be considered therewith. Two African forms appear to have been described, *viz.* :—

α. var. *phlaeoides*, Staud., "Cat.," 3rd ed., p. 74 (1901). *Phleas* var., Baker, "Trans. Ent. Soc. Lond.," p. 200 (1891).—Alis posterioribus subtus fascia antimarginali dilutiore (cinerea) distincta. Madeira (Staudinger).

Baker states (*Tr. Ent. Soc. Lond.*, 1891, p. 200) that, in Madeira, "the species is common; the usual form of the species very dark, both the wings being suffused all over with very dark scales. Paler specimens are evidently rare, the ordinary ones being certainly darker than var. *eleus*. I have before me specimens from almost every country where it obtains, but, with the exception of one extraordinary and almost black *eleus* from Broussa, none are as dark as the Madeira insects." He adds (*in litt.*): "I have about twenty Madeiran specimens, the majority of which are the form *phlaeoides*, Staud., and, to my mind, it is the finest form, though not the largest; they are deep-red copper, strongly suffused with bronzy-brown, with large dark spots, very broad termen, and secondaries with the red border narrow, the spots below on secondaries obsolete, their place being taken by a dark suffused band. Two of the examples are almost like typical English specimens as to their upperside, all the Madeiran specimens, therefore, not being of the dark form. They all came from the hills, and were, no doubt, all taken before mid-July."

β. var. *pseudophlaeas*, Lucas, "Ann. Ent. Soc. Fr.," p. 499 (1866); Auriv., "Rhop. Æthiop.," p. 382 (1898).—This species (*phlaeas*) also inhabits Abyssinia, but the specimens coming from this part of Africa are very remarkable on account of the pale tint of the wings above and beneath, and are so far distinctly modified by climatic influences as to form an excessively curious variety. This variety, which might even form a distinct species near *C. phlaeas*, is distinguished by its constantly pale ground colour, by the hollowing of the outer border which is scarcely marked, and by the anal angle which terminates in a very prolonged tail, and for it I propose the name of *pseudophlaeas*.

### Variation of the western forms.

Our western (European and North African) *phlaeas* are subject to considerable variation in size, colour, markings of the forewings, markings of the hindwings, etc. In size, specimens vary from about 18mm. to 38mm., in wing expanse, both these measurements being extreme in opposite directions. Pfitzner records a ♂ only 20mm. in expanse, taken in the Sprottauer Haide, August, 1898, whilst Hill notes one taken at Sandy, in Bedfordshire, 21·9mm. in expanse, the same size as the smallest noted by Frohawk (*anteà*, p. 341). Those examples under 22mm., however, we should consider very small and suggest for them the name ab. *minor*, n. ab.; those above 32mm. are abnormally large, and might be termed ab. *major*, n. ab. In ground colour there are several shades. The well-known white form, ab. *alba*, has long been erroneously called *schmidtii*; the brassy-coloured form is known as *intermedia*: the clear copper or golden-red is the typical *phlaeas*; whilst it is suggested that the intense bright fiery-red form should be known as *ignita*, n. ab. All these various colour forms may be, themselves, subject to various modifications of markings, both in the fore- and hindwings, and necessitate a combination of two aberrational

names to distinguish them. Speiser says that examples with larger or smaller albinistic patches on the wings are not rare in Prussia. Many similar pathological aberrations, in which the pigment more or less fails, have been recorded in Britain as approaching ab. *schmidtii*, etc. We do not consider ab. *alba* or ab. *schmidtii* to be pathological aberrations, in the sense of those presenting pallid spots or patches in an otherwise normal wing. We have, therefore, separated such from our consideration of the forms *alba* and *schmidtii*, and give here notes on apparently really pathological examples :—

(1) A ♂ taken August, 1904, at Tintern, has the outer portion of the left forewing pallid, the pale area forming an irregular patch from the apex to middle of inner margin, the copper colour being more affected than the black spots and border; the hindwing also, on that side, has two small whitish splashes on the marginal band (J. F. Bird, *in litt.*).

(2) A grey and straw-coloured ♂, having one side paler than the other; all the wings very shiny and somewhat iridescent. Several other examples with portions of one or more wings pallid or bleached (Sabine, *Ent.*, xxxii., p. 284).

(3) An aberration with the costal margin of both forewings, the outer margin of the right forewing, and the marginal band of both hindwings white, the hind-margin of the left forewing normal. It is, therefore, entirely bordered with white except this one margin, and has a very curious appearance. Captured on railway embankment at Hartlepool (Robson).

(4) A specimen with four orange spots on forewings, and two orange spots on hindwings (Harper, *Ent.*, xxviii., p. 360).

(5) A pale fawn-coloured aberration, taken at Worcester, July 24th, 1865 (Edmunds, *Ent. Mo. Mag.*, ii., p. 236).

(6) A specimen taken near Carlisle, in 1899, with a large bleached patch on the right forewing (F. H. Day, *Victoria County Hist. Cumberland*).

(7) A specimen with a white silvery blotch on each forewing at Fort Rowner, Gosport, on August 16th, 1892 (Mackett, *Ent.*, xxv., p. 288).

(8) A partly silvery specimen taken at Benfleet, without further detail, is recorded (Battley).

(9) An example with one of the hindwings whitish (Clark, *Ent.*, v., p. 260).

(10) A specimen bleached to a straw-colour approaching ab. *schmidtii*, taken near Favour Royal, co. Tyrone. Another with only one forewing of this form, all the rest of the insect being normal (Kane, *Ent.*, xxvi., p. 241).

(11) An aberration with the outer portion of the normal copper of the forewing bleached, and almost white, the base and disc retaining the copper hue; the hindwings normally coloured, and of the *caeruleopunctata* form. Capper collection [Mosley, *Vars. of Brit. Lep.*, p. 11 (1896).]

(12) A specimen with the coppery scaling broken up by orange markings (Webb, *Ent.*, xxi., p. 133).

(13) A bred example with one wing cream-coloured, the others the typical colour (Peyerimhoff, *Cat. Lep. Als.*, p. 23).

(14) An abnormal specimen with the left inferior wing small and pale (Fenn, *Proc. Sth. Lond. Ent. Soc.*, 1890, p. 44).

(15) An example taken at Beckenham, August, 1886, the left hindwing being almost white (Buckstone, *Proc. Sth. Lond. Ent. Soc.*, 1899, p. 109).

(16) A pale creamy patch on the left forewing towards the apex, and involving part of the transverse submarginal row of spots. Taken August, 1898, in Fontainebleau Forest (Tutt collection).

(17) A specimen from the river Mälso has a light whitish-yellow spot indistinctly defined on both forewings (Schneider, *Tromsö Mus. Aarsh.*, xv., p. 20).

The following (among many other) bizarre, and unclassifiable, forms have been recorded by various lepidopterists :—

(1) An aberration, taken at Doncaster, September 3rd, 1895, the upperside normal, except that the hindmarginal band of the hindwing is slightly paler than usual, but on the underside of the same wing there is a large patch coloured like the forewing, *i.e.*, with black spots on a tawny ground (Corbett).

(2) An aberration with ocellus on underside of left hindwing, similar to the marginal ocelli on the underside of anterior wings. Captured in North Devon in 1881 (South).

(3) A specimen, captured in the Isle of Wight, with a small patch of copper with a black spot in it on the underside. This gave me the idea of a clumsy attempt at patching, but the insect was taken by myself, and, of course, the colouring was quite natural (South).

[(4) The undersurface of the right hindwing marked by red dashes running from base to exterior margin (*Bull. Brooklyn Ent. Soc.*, ii., p. 8).]

(5) Two odd-sided examples, the spots or markings quite different on the two forewings in each case. Erith, September, 1899 (Sabine, *Ent.*, xxxii., p. 284).

## Variation in colour of markings.

*a.* ab. *hübneri*, n. ab. *Phlaeas* var., Hb., "Eur. Schmett.," figs. 736-7 (*circ.* 1805); Humph. and Westd., "Brit. Butts.," pl. xxviii., fig. 8 (1841).—Hübner figures (736-737) the upperside and underside of an example of *phlaeas*, in which all the ordinary ruddy ground colour of the fore- and hindwings is coppery, as in the type, but the margin of the forewings is blackish-grey, rather darker towards the apex; the usual spots are present, but white; whilst the hindwings have the whole of the usual dark parts whitish—the basal, central, and narrow outer-marginal areas—the usual copper hindmarginal band alone being of the normal colour. The underside is similar, all the usual dark parts are pale grey, whilst on the hindwings the basal area is pale, followed by a greyish band, then by the normal copper band, and lastly by a narrow, grey, outer-marginal edging. This figure is, no doubt, that which Humphreys and Westwood have figured (*Brit. Butts.*, pl. xxviii., fig. 8), but they have made the copper colour bright yellow, and all the rest of the wings (including the spots) white. Barrett refers to this figure (*Lep. Brit. Isles*, i., p. 63).

It is amazing that almost all authors, including Staudinger (*Cat.*, 2nd ed., p. 9), have referred Hubner's figures to *schmidtii*, Gerh., combining them with Esper's figure as the latter form. The form figured is, in fact, exactly the converse, for, whereas in Esper's figure the ground colour is changed to white, and the black spots are normal, in Hübner's figure the spots are changed to white, and the ground colour is normal. Sepp copied Hübner's figure in the frontispiece of the *Besch. Ned. Ins.*, vol. v., but the colouring is somewhat different.

*β.* ab. *webbi*, n. ab.—The coppery parts normal; the spots on forewings sooty; the other parts replaced by creamy-drab. [This appears to be, in spite of the difference in the choice of colour terms, the specimen described by Barrett (*Lep. Brit. Isles*, i., p. 63) as having the coppery parts normal; the spots of the forewings of a faint lead-colour; the usually black margins and hindwings pale yellow.]

*γ.* ab. *infuscata*, n. ab.—The coppery parts replaced by pale creamy-drab; the spots and borders of forewings sooty; the hindwings darker drab.

One supposes that the two last named examples described by Mosley [*Vars. of Brit. Lep.*, p. 11 (1896)] from the "Webb" collection, might almost be referred to the pathological group. He describes another example as having "the coppery parts normal; the spots blackish; the hindwings and margins of forewings drab," which appears to fall within the limits of ab. *webbi*.

## Variation in ground colour.

*a.* ab. *alba*, n. ab. *Schmidtii*, Snell., "De Vlind.," p. 64 (1867); Staud., "Cat.," 2nd ed., p. 9 (1871); Lang, "Butts. of Europe," p. 96, pl. xxii., fig. 1 (1884); Kane, "Eur. Butts.," p. 31 (1885); Barrt., "Lep. Brit. Isles," i., p. 62, pl. ix., fig. 2*a* (1893); Rühl, "Pal. Gross-Schmett.," pp. 218, 747 (1895); Tutt, "Brit. Butts.," p. 153 (1896); Obth., "Etudes," etc., p. 12, pl. v., figs. 70-71 (1896); Staud., "Cat.," 3rd ed., p. 74 (1901); Lamb., "Pap. Belg.," p. 208 (1902); Wheeler, "Butts. Switz.," p. 18 (1903). *Phlaeas* var., Esp., "Eur. Schmett.," ii., p. 62, pl. lx. (contd. x.), fig. 5 (1786); Stphs., "Illus. Haust.," i., p. 80 (1828); Westd., "Brit. Butts.," i., p. 94, pl. xxviii., fig. 8 (1841); Newm., "Brit. Butts.," p. 115 (1869).—The usually coppery portions of the fore- and hindwings of a beautiful shiny silvery-white; the black markings normal. British localities.—Aber-

DEEN: Pitcaple (Reid). BERKS: Streatley, Henwood (*Vict. Count. Hist.*). CUMBERLAND: near Carlisle (F. H. Day). DERBY: Derby (Hill). ESSEX: on the coast, St. Osyth (Harwood). GLOUCESTER: Bristol (Allis). HANTS: Ringwood (Fowler), Winchester (Tomlin), Portsmouth dist., Highgrove (King), Isle of Wight (Sequeira)—Shanklin (Leech). HEREFORD: Hereford (Blathwayt). HERTS: Watford (Arkle). KENT: Blackheath (Green), Plumstead Common (Dawson), Dartford Heath (Youens), Folkestone (Giles), Erith (Sabine), Beckenham (Buckstone), Birch Wood (Stephens). LANCS: Oldham (Edleston). NORTHUMBERLAND: Newcastle (Rosie). NOTTS: Sherwood Forest (Birchall). OXFORD: Oxford (Holland). PERTHSHIRE (Carrington). RENFREW: Paisley (Stewart). STAFFORD: Barlaston Down (Frohawk). SURREY: Croydon (Long), West Norwood (Harley-Mason). SUFFOLK: Near Ipswich (Stephens). Stoke-by-Nayland (Mathew). SUSSEX: Tilgate Forest (Tugwell). TYRONE: Favour Royal (Kane). YORKS: Newby (Leighton), Strensall Common, Sandburn, Thirsk (Walker), near Huddersfield (Porritt), Doncaster (Clark). CONTINENTAL DISTRIBUTION.—FRANCE: Fontainebleau (Kane), Maine-et-Loire—St. Christophe-du-Bois (Delahaye), Digne (Oberthür). GERMANY: Prussia, near Wargen (Macy), Warnicken (Draudt), both of these in August (Speiser), Boberg, near Hamburg, in July (Tessien), near Parchim, end of July, 1877 (Gillmer), a ♀ on the Hülserberg, near Krefeld, in August, 1895 (Rothke), near Wiesbaden (Blum), on the field-path between Niederkaufungen to the Stiftswald, in July (Borgmann), occurs rarely among the typical forms in Thuringia (Krieghoff), two near Gotha (Knapp), one near Wahren, and one in the Hohburger Schweiz (*Verein Fauna, Leipzig*); several times captured near Weinheim (Meess and Spuler), Eutin (Gerhard). ITALY: near Florence, prov. Lucca—Viareggio (Verity). NETHERLANDS (Snellen). SWITZERLAND: Martigny (Sloper).

Esper, who first figured this form, calls it "*Plebeius Ruralis phlaeas* var.," and says that his "fig. 5 shows that the copper colour of *phlaeas* may change into white; the upperside is as fresh in colour as in the ordinary form, but the ground colour is white; on the pale-coloured underside, however, one observes the almost obsolete pale red-yellow marginal band; the specimen figured was taken in a meadow near Neustadt-on-the-Aisch, and is in Gerning's collection." Esper's figure (pl. lx., contd. x., fig. 5) is excellent; the usual dark part and spots of inky blackness; the ground colour of the wings pure white; the underside of the forewings also shows the white ground colour, with black spots and grey margin. The hindwings rather brownish-grey, strongly sprinkled with tiny black dots, and showing a row of yellow marginal lunules edging a series of black lineations. This is the var. η of Stephens, who describes it as having "the disc of the wings pure white, but the spots and borders as in the type." Oberthür figures two ♂ s (*Études*, etc., 1896, figs. 70-71), one taken in England, the other at Digne, and also notes (*op. cit.*, p. 12) a ♀ from Tilgate (Tugwell collection). Lang describes it as the form in which "all those portions of the wing that are normally copper-coloured, are brilliant shining white," his figure being taken from a specimen captured in Perthshire. He further adds that "it is found most commonly in the southern districts of the territory inhabited by *phlaeas*, but it occasionally occurs in the more northern parts." The records seem to show it to be commonest in the more central parts of its area in Europe. Many examples have been taken in the British Islands, and the dates of capture show that they are not confined to a particular brood, although taken more frequently in the autumn, *e.g.*, a specimen May 19th, 1868, at Doncaster, the part usually of a bright copper colour being of a splendid silvery-white; it is also a very large example (Clark); one with the copper colour superseded by silvery-white, at Shanklin, in October, 1880 (Leech); a beautiful silvery-white aberration at

Giffords Hall, Stoke-by-Nayland, October 4th, 1893 (Mathew); one fine example taken September 9th, 1896, at Erith (Sabine); one with all the parts usually copper-coloured, silvery-white, with a slight tinge of cream at the base of the wings, taken September 18th, 1893, at Hereford (Blathwayt); a specimen in which the copper ground colour is replaced by white, at Bristol (Allis); in our own collection we have an example with the ground-colour white, the spots of the forewings quite black, the outer marginal border brownish-black, the hindwings of the same tint, the ordinary marginal copper band of the latter white, like the ground colour of the forewings; the specimen was caught near Dundee, in 1886, by Kirk. Other recorded captures are August, 1870, near Huddersfield (Porritt); a ♀, August 18th, 1872, in Sherwood Forest (Birchall); June 20th, 1889, on Plumstead Common (Dawson); August 28th, 1889, on Dartford Heath (Youens); August, 1889, at Folkestone (Giles); at Croydon (Long); September 24th, 1899, at West Norwood (Harley-Mason); September, 1901, near Paisley (Stewart); October 11th, 1901, at York (Walker); August 5th, 1906, at Chingford (Pether); Gregson notes (*Ent.*, iii., p. 211) six examples in his collection, with all the copper colour replaced by silver, one of which, he says, is truly magnificent. Fowler notes the capture of an example of ab. *alba* and several others approaching it, at Ringwood. Sloper records the capture of a specimen, August 13th, 1901, at Martigny. Of specimens of the *alba* form taken in Italy, Verity notes (under the name *schmidtii*) (*Ent.*, xxxvii., p. 57) three examples taken in the neighbourhood of Florence, in September, 1901, one with the marked tails of *eleus*, the other two slightly suffused with pale coppery reflections; five also, in 1903, near Viarreggio, one pure milky-white, another with metallic reflections, the third with both left wings normal, the right wings of *schmidtii* (*i.e.*, *alba*) form (ab. *dextroalba*); a fourth with the forewings pure white, but the submarginal band of hindwings copper colour (ab. *anteroalba*), whilst a fifth is exactly the reverse of this, having the forewings of normally bright colour, but the band of hindwings white (ab. *posteroalba*). Hering notes (*Stett. Ent. Zeitg.*, 1840, p. 155) the capture of an example, like one of those mentioned by Verity, *viz.*, with white forewings, the black markings normal, and the hindwings of the usual colouring; Gregson notes a similar aberration (*Ent.*, iii., p. 211) described as having "both forewings silvery, the hindwings normal." In the Tugwell collection was an aberration with only one white wing; Gregson also describes (*loc. cit.*) another with one silver forewing, and all the rest normal, whilst Jordan records the capture, in the Visp valley, at the end of June, 1878, of an example with one white forewing, the other three wings being normal. Fuchs calls a pathological specimen with the inner half of left forewing whitish, etc. (*Stett. Ent. Ztg.*, 1889, pp. 249-250), ab. *albicans*.

β. ab. *alba-caudata*, n. ab. *Phlaeas* ab., Verity, "Entom.," xxxvii., p. 57 1904).—The ground colour white, the markings normal, as in ab. *alba*, but the hindwings showing the distinct tails of the *eleus* form.

Verity records (*Ent.*, xxxvii., p. 57) the capture in the neighbourhood of Florence, in September, 1901, an example of the ab. *schmidtii* (*i.e.*, our *alba*) with the marked tails of *eleus*.

γ. ab. *schmidtii*, Gerh., "Beit. Schmett," p. 7, pl. x., figs. 3*a*-*b* (1853). *Phlaeas* var., South, "Entom.," xxvi., p. 305 (1893).—This beautiful and peculiar aberration of *phlaeas* was figured by Hübner and Esper, and is also mentioned by

Ochsenheimer. It is extremely rare, although now becoming more frequent in collections; the specimen that I possess was caught by Schmidt, in a pasture at Eutin (Gerhard). [The ab. *schmidtii*, Gerh., is the pale creamy form, not, as is generally assumed by lepidopterists, the silvery-white one. Gerhard's pl. x., fig. 3*a* (upperside) and fig. 3*b* (underside) have the ground colour pale cream, this tint supplanting the ordinary copper colour, both on the forewings and the margin of the hindwing, the dark parts of the wings—outer margin of forewings and base of hindwings—being brown. Gerhard's reference of Hubner's figs. 737-738, our ab. *hübneri*, and Esper's pl. lx., fig. 5, our ab. *alba*, to his *schmidtii* is quite inexplicable, as neither of these aberrations at all resembles the Eutin example that he figures under this name.]

This aberration, in which the parts of the wing usually copper-coloured are of a creamy tint (variously described as "straw-colour," "pale yellow," and "intermediate between the type and *schmidtii*"), is occasionally met with in Britain. An example of this form is described in detail by South as follows: "The forewing shining pale straw-colour; the costa is broadly black along the apical half, and suffused with black along the basal half; the outer margin is also broadly black, and the spots are typical. Hindwings black; marginal band rather broader than usual, and of the same straw-colour as forewings; base of wings dusted with shining straw-coloured scales; fringes greyish-white; undersurface of forewings pale straw, but quite typical in all other respects; of hindwings typical. Captured by Sabine, September 7th, 1893, near Dartford." Of this form, Chittenden notes (*Ent.*, xxxiii., p. 317) the capture of a pale yellow specimen at Ashford, Kent. Ruston records that, in August, 1873, an example was taken at Chatteris, in which all those portions of the wing, usually red, were of a light cream colour on the upperside, the underside of a dull stone-colour, instead of reddish-brown as in the type, which, however, it resembles in all other respects. Harpur-Crewe records the capture of a straw-coloured specimen at Erwarton, near Ipswich, in 1857 (*teste* Bloomfield, *Lep. of Suffolk*). Kenward exhibited at the meeting of the South London Entom. Society, held January 12th, 1893, pale straw-coloured aberrations of *phlaeas* taken in Kent during the year 1892. Kaye records the capture of a "yellow" example on June 9th, 1902, on the shores of Caragh Lake, Kerry. Harding notes the capture, at Church Stretton, September 9th, 1906, of a specimen with the ground colour of a lovely creamy-silver, the spots greatly enlarged and much clouded (*Ent.*, xxxix., p. 235).

δ. ab. *schmidtii-caudata*, n. ab.—Of a pale creamy ground colour, with typical markings, but the hindwings tailed.

ε. ab. *cuprinus*, Peyer., "Cat. des Lép. d'Alsace," 1st ed., p. 8 (1871); 2nd ed., p. 23 (1880).—Pallide lutea. Pâturages les plus élevés des Vosges—Hohneck, Rotabac, etc., Basses-Rhin—vallée d'Andlau.

One supposes this may be translated "pale yellow." Whether this is a special mountain race or not is doubtful. It may have to be referred to our ab. *schmidtii*.

ζ. ab. *intermedia*, Tutt, "Brit. Butts.," p. 153 (1896); Wheeler, "Butts. of Switz.," p. 18 (1903).—Ground colour brassy, instead of bright coppery-red; markings as in the type (Tutt).

This form is not at all uncommon, especially in the early brood, and it has been repeatedly taken in various localities. Glover notes that, at Guildford, the species is triple-brooded, the first brood always scarce, and "the few specimens obtained of it so far, all agree with ab. *intermedia*, Tutt, the forewings being brassy or golden, instead of

coppery." Sabine records the capture of a gold-coloured ♂, in September, 1899, near Erith, he also states that he bred an example, in July, 1903, at Erith, of a "pale golden" colour, whilst, in September and October, 1904, he bred nine examples of this golden aberration, which formed a striking contrast with the very typical forms he also bred from the same lot of larvæ. Clark notes the capture of an example of a brassy or yellowish tint (*Ent. Rec.*, iii., p. 214). Harwood records pale golden forms from the coast of Essex. Our own British examples, strangely, appear to be all summer captures, a long series of twelve fine specimens from Kingsdown, August 1st-3rd, 1887; two from Arran, August 15th, 1893; and one from Cuxton, September, 1893. Our continental captures, on the other hand, suggest that it may not be uncommon among the spring emergences in South France; thus, we have examples from Auribeau, near Cannes; Hyères, where several examples, taken in the Plan-du-Pont, April 27th, 1905, were of this form, as well as a single one captured at Costebelle, April 24th, 1905; some of these specimens are of an exceedingly pale tint, inclining distinctly to the brassy hue of *intermedia*, the spots distinctly small. Lowe says that ab. *intermedia* is not infrequent in Guernsey. Fletcher observes that a strange aberration was taken on the "Great Wall" at Shan-hai-kwan, on September 19th, 1898, with typical markings, but with the ground colour of a very pale golden-yellow, and the usual black markings irrorated with golden scales; the black spots on the forewings very small, and the marginal band on the hindwings much enlarged.

η. ab. *intermedia-caudata*, n. ab.—Like ab. *intermedia* in colour and markings, but with the tails of the hindwing developed as in *eleus*.

This is a most unusual form in Britain. We have ourselves several specimens among our *intermedia*, taken at Kingsdown, August, 1887; Cuxton, September 10th, 1891, etc. One suspects, however, that it is not so uncommon in the south of France, as we have examples from Auribeau, ♀, April 8th, 1903; Hyères, ♀, April 27th, 1905, etc.; also from Fontainebleau, June 28th, 1897; whilst a ♀ at Susa, mid-August, 1897, was a most unexpected capture. One is recorded by Mrs. Holmes from near Sevenoaks, of the colour of brass, with two projections on the lower wing.

θ. ab. *typica-caudata*, n. ab.—Of the ordinary typical colour and markings, but with the development of the hindmargin of the hindwings into tails, as in ab. *eleus*.

In July, 1903, Sabine bred, from the Erith district, a normally coloured example with abnormally long tails, and, as a rule, this form is considered a rare aberration in Britain; although we have several examples taken in August, 1887, at Deal; one at Cuxton (ab. *minor*), on September 10th, 1891, Canterbury, August, 1890, etc. In southern France, however, where the spring specimens are normal in colour, the tails are often very well developed, and we have such from Hyères, ♀, March 30th, 1903; Auribeau, ♂, April 6th, 1903; Locarno, 2 ♂s slightly, 1 ♀ strongly, tailed, May and June, 1902, etc. But they also occur in other districts in the summer, *e.g.*, we have examples from Fusio, ♀, July 12th, 1899; Broncbales, ♂, August 3rd-5th, 1901; Albarracin, ♀, July 28th, 1901; Fontainebleau, several ♂s, mid-August, 1899; Malta, three large ♀s, July 17th, 1897; Le Batiaz, near Martigny, small ♀, August 25th, 1905, etc. Others of

the bright *ignita* ground colour = *ignita-caudata*, are in our collection from Aosta, mid-August, 1898; Bejar, ♀, July, 1902, etc.

ι. ab. *purpureotincta*, n. ab.—The ground colour of a deep copper hue, tinged with purple. Marked like the type.

Sabine records the breeding, in July, 1903, from larvæ found in the Erith district, two examples of a very much darker copper hue, tinged with purple on the basal half of the wings.

### Variation in markings of forewings.

α. ab. *obliterata*, Scudd., "Butts. New Engl.," ii., p. 1001 (1889). *Phlaeas* var., Stphs., "Illus. Haust.," i., p. 80 (1828); Gerh., "Beit. Schmett.," pl. xxxix., figs. 6*a-b* (1853). *Phlaeas* ab., Obth., "Études," etc., p. 13, pl. v., fig. 72 (1896).—In this there is a partial and nearly complete obliteration of the extra-mesial spots of the front wing, both above and below. One such specimen is figured by Maynard (*Butts. New England*, pl. v., fig. 52*a*) with no spots at all, but the most extreme case I have ever seen has some dots left. Curiously, the most persistent of all the spots, whether above or below, is the upper of the two beyond the cell, which is sometimes reduced to the merest dot of black (below, encircled with white). The two cellular spots remain unchanged, etc. (Scudder).

Oberthür combines (*Etudes*, etc., 1896, p. 13), under the description "supra minus punctata," Scudder's ab. *obliterata* and our ab. *bipunctata*, and says that, in this form, "the ordinary black submarginal spots of the upper wings are disappearing; the figures are taken (no. 72) from a ♀ captured at Cancale in August, 1893, and (no. 73) from a still more extreme ♀, taken at Vernet (Pyrénées-Orientales) in July, 1894. The individual figured by Gerhard (pl. xxxix., figs. 6*a-b*) belongs to this aberration, but, in addition, appears to show a tendency to albinism, since the normal fiery colour is replaced by a pale tint. Herrich-Schäffer, however, had (*Sys. Bearb.*, figs. 521-2) already figured the same specimen, which Gerhard really only copied, and very badly coloured." Oberthür's fig. 73 is a very fine example of our ab. *bipunctata*, only the discoidal spot and a small discal dot between this and the base of the forewing being present; fig. 72 shows, in addition, a trace of the submarginal series as tiny black points. It is Stephens' var. γ, which is described as having "the forewings of a pale rufous-copper, with the spots very small, and several of the inner ones obliterated." We captured an example, the ground colour, however, of the *intermedia* form, in the Isle of Arran, August 15th, 1893, the three spots forming the costal series, and the lowest one of the row, alone being noticeable. Fowler records the capture of examples at Wimborne, in 1888, with scarcely any spots at all. Crass captured an example at Prestwich Carr, with several of the black spots on the forewings suppressed. Hamm records similar specimens from the Reading district, also in 1893, and exhibited an example at the meeting of the South London Entomological Society, held May 24th, 1894, in which the usual black spots were represented only by three apical and two costal dots (*Proc. Sth. Lond. Ent. Soc.*, 1894, p. 39).

β. ab. *bipunctata*, n. ab. *Americanus* var., Mayn., "Butts. New Engl.," v., p. 41, fig. 52*a* (1886). *Phlaeas* ab., Obth., "Études," etc., pl. v., fig. 73 (1896).—All the spots of the submarginal transverse row absent, the spotting of the forewings restricted to the two in the discal cell.

Oberthür gives an excellent figure (*Études*, 1896, pl. v., fig. 73) of this form, a ♀, which was taken at Vernet-les-Bains in July, 1894. Barrett observes that a British example with only two spots on the

forewings is in the "Webb" collection. Scudder records that Maynard (*Butts. New Engl.*, v., fig. 52*a*) figures an American example of this form, of which Maynard observes (*op. cit.*, p. 41) that, "in some examples, the band on the forewings is quite narrow, and there are only two spots, these being in the central cell; in these examples the spots on the underside are often normal." The aberration, however, must be exceedingly rare.

γ. ab. *unipunctata*, n. ab. *Phlaeas* ab., Nussey, "Proc. Sth. Lond. Ent. Soc.," p. 44 (1893); "Ent. Rec.," iii., p. 215 (1893).—A still more extreme form in the direction of obliteration, only the median spot on the forewing being present.

This is a still rarer form of the type with obliterated markings, all the black spots of the forewings being absent except the discoidal one. It is recorded (*Ent. Rec.*, iii., p. 215) that Nussey exhibited at the South London Entomological Society, held on August 25th, 1892, an example with only the central spot on the forewings present.

δ. ab. *impunctata*, n. ab.—Without any spots on the forewings, the whole area of the wing, from the outer marginal band to the base, and from costa to inner margin, being of an uniform copper colour.

Barrett notes that in the "Capper" collection is a specimen devoid of spots.

ε. ab. *remota*, n. ab. *Phlaeas* ab., Obth., "Études," etc., pl. v., fig. 75, p. 13 (1896).—This is described by Oberthür as 'punctis nigris remotis.' The six black submarginal spots undergo a displacement towards the margin, and, at the same time, may be reduced to four points; the example reproduced in fig. 75 is an English example from the collection of Howard-Vaughan. A ♀ from the Sheppard collection is an exaggeration of this form; except the two cellular spots, which remain normal, the other spots of the upper wings are only indicated by single blackish scales.

The essential character of this form is less the small size of the submarginal row of dots than their movement towards the outer margin. We have not often met with extreme forms of this species, the best being examples captured in Fontainebleau Forest, June 28th, 1897, in which the spots are small, and well out towards the margin, as described by Oberthür, and one taken at Cannes, in April, 1898. One notes also the same peculiarity in some of the Locarno examples taken May and June, 1902, whilst others, captured at the same time and place, have the spots also placed quite close to the outer marginal band, but, instead of being small, they are somewhat elongated and form an excellent combination of the *remota-juncta* characters. From Malta, too, we have examples, taken in March, 1897, in which the dots are small and far out towards the margin.

ζ. ab. *parvipuncta*, Strand, "Nyt. Mag. f. Natur.," xl., p. 163 (1902).—With very small and widely separated spots in the transverse row, sometimes only indicated by indistinct points (Strand).

This aberration almost falls within the limits of ab. *remota*, but the spots are not moved towards the margin, and it differs from ab. *obliterata* in that none of the spots are actually absent. Strand named this form from six Scandinavian examples, taken in the Suldal, in August, 1901, which he described as "having very small, widely separated, spots in the transverse row, sometimes only indicated as indistinct points." Schöyen also notes the form as occurring in Finmark. We have a very good example taken in Fontainebleau Forest in mid-August, 1899. Some of the specimens from the Cannes district, taken in March and April, and from the Locarno district

in April and May, approximate to, but do not fully reach *obliterata*, the spots being small without being really absent. There appears to be a tendency to very small spots in the transverse submarginal row, in many of the examples taken in the Riviera in spring. Adkin notes the capture, on September 4th, 1893, of examples at Eastbourne, with the submarginal row of black spots on the primaries reduced to minute dots.

η. ab. *magnipuncta*, n. ab. *Phlaeas* var. β, Stphs., "Illus. Haust.," i., p. 80 (1828).—The black spots in the submarginal transverse row crossing the forewings much larger than usual, but not actually united.

This is the var. β of Stephens, who diagnoses it as having "the anterior wings above of a deep dusky-copper, with very large, nearly confluent, spots; the posterior wings with a very narrow waved band." Adkin notes a specimen from Eastbourne, with large spots, the costa and nervures thickly dusted with black scales. Mathew observes that Teneriffe specimens have much larger black spots than British examples. We have a ♀ with a particularly large, outer, discal spot, taken at Stresa, on August 20th, 1905, etc.

θ. ab. *juncta*, n.ab.—The spots, forming the transverse submarginal row that crosses the forewing, large, but quadrate, united to each other directly, or by short dark streaks, along the nervures, so as to form an united zigzag band across the forewings.

Raynor notes (*in litt.*): "The aberration in which the submarginal series of black spots on the forewings coalesce more or less completely, I have from Hunstanton, August, 1899; also a specimen from Erith, taken by Sabine, and one at Colchester, by Harwood, August, 1906." This is really a well-marked and frequent aberration, wonderfully well shown in some of the specimens experimented on by Chapman, and to which reference has already been made (*anteà*, pp. 336 340). We have British examples taken at Deal, August, 1887, Canterbury, August, 1890, Cuxton, September 10th, 1891, Kingsdown, August 1st, 1897, etc. We also possess such examples from Locarno, taken May and June, 1902, some having the characters of this aberration combined with those of *remota*, the specimens having the spots joined zigzag fashion, yet pushed out so as almost to touch the outer marginal band, to which they are united by black nervures. This is remarkable, as the spring specimens in the Riviera have both small and distant spots. A very good ♂ of this form was found on the Brévent, in mid-August, 1902. The aberration was also common in certain specimens taken in mid-August, 1899, at Fontainebleau; most of these latter were also tailed, so that they form a combination of *juncta-caudata*; another of this combined form was taken at Le Batiaz, near Martigny, on August 25th, 1905. The character of this aberration is frequently exhibited by examples of the *suffusa* and *eleus* forms, *e.g.*, near Stalden, August 5th, 1904, a suffused ♂ of the *juncta* form was captured, whilst, in Spain, it is a striking feature in many dark specimens captured at Cuenca, Moncayo, Bejar, Albarracin, etc.

ι. ab. *kochi*, Strand, "Nyt. Mag. f. Natur.," xl., pp. 162-3 (1902). *Phlaeas* ab., Obth., "Études," etc., p. 13, pl. v., fig. 74 (1896).—The spots, which form the transverse row beyond the middle of the forewings very large, elongated on the inner side in a wedge-like manner and touching each other. Two examples, taken on the dry, sun-baked, stone-covered slopes in the Suldal (Strand).

The transverse row of black spots crossing the forewings, between the discoidal cell and marginal band, on the upperside, considerably

elongated, the spots usually becoming somewhat wedge-shaped, the pointed ends directed towards the base. This is the aberration described by Oberthür as "supra radiata," of which he gives an excellent figure (74), a ♀ taken at Vernet-les-Bains in July, 1894. He describes it as having the normally square black spots, comprising the submarginal row on the forewings, replaced by a series, each of which is elongated in the form of a "goutte," and adds that "the Guénee collection contained a ♀ from Châteaudun, presenting a slightly weakened example of this form of the species, but on the underside instead of the upper, whilst from the Howard-Vaughan collection came an analogous ♂ from Folkestone, but more characteristic." Sabine notes (*Ent.*, xxxii., p. 284) the capture, in September, 1899, in the Dartford district, of some four or five examples, with elongated, wedge-shaped spots, approaching streaks. Mitchell records the capture, at Barnes, of a specimen with the spots on the forewings very large and elongated. Adkin notes (*Ent.*, xxvi., p. 365) the capture, at Eastbourne, of examples in which the black spots comprising the submarginal row on the forewings show a tendency to elongation; and Barrett (*Ent. Mo. Mag.*, xxv., p. 83) mentions one taken at King's Lynn, which was of normal colour, but had the black spots doubly wedge-shaped. We have a specimen of the *intermedia-caudata* form, taken August 1st, 1887, at Kingsdown, in which the spots have undergone some extension in the direction of this aberration.

κ. ab. *extensa-conjuncta*, n. ab. *Fasciata*, Scudd., "Butts. New Engl.," ii., pp. 1000-1001, *in part* (1889). *Phlaeas* var., South, "Ent.," xxxvi., p. 289 (1903).—With the black spots of the transverse submarginal row on the forewings, enlarged as in ab. *extensa*, but, in addition, the 2nd and 3rd united to the discoidal spot.

This is a very rare form. Of this aberration we give two representations, both apparently ♀s (pl. xiii., figs. 7-8). An example of this form was captured on Wanstead Flats by J. A. Cooper, and is figured *Ent.*, xxix., p. 191, the spots in the transverse submarginal band on the upperside of the forewings being developed into lineolæ, pointing towards the base of the wing; it is noted, however, that the elongation of the spots is confined to the uppersurface, the undersurface being completely normal; [an analogous underside example is figured, *Ent.*, xxvi., p. 305, fig. 1, captured by Sabine, at Erith, in 1893.] South records (*Ent.*, xxxvi., p. 289) the rearing of a ♀, by Sabine, in July, 1903, in which spots 1, 2, 3 and 5 of the antemarginal series are extended inwards, forming conspicuous black bars; 2 and 3, in addition, being united with the outer discal spot. Adkin notes (*Ent.*, xxvi., p. 365) the capture, at Eastbourne, of a form approaching this aberration, in which the 3rd spot of the submarginal series is connected with the discoidal spot by a black streak. Scudder, under the term *fasciata*, includes (*Butts. New Engl.*, ii., pp. 1001-2) several aberrations of the fasciated type. Among others, he describes the one (*extensa-conjuncta*) under consideration, from "two examples taken August 1st, at Newton, Mass., within a few minutes of each other, which are almost exactly alike, the variation affecting only the row of spots in the middle of the outer half of the wing, each of which, although perfectly distinct from the others, is expanded a very little exteriorly and very much interiorly, the spots beyond the cell joining that which borders the outer limits of the same, those in the median

interspaces extending nearly, or quite, to the base of the interspaces (in one instance, the spot in the lower median interspace reaches only halfway to the base), and that of the medio-submedian interspace is, in one instance, as long as broad. On the under surface the wings are of the normal pattern." He then adds that these suffused specimens are by no means excessively rare, that he has taken them himself in several places in eastern Massachusetts, that Sprague has found them in Wollaston (July 10th and 27th), that Edwards has a long series captured in and about Readville, all in places in the vicinity of Boston, where they appear to have been most frequently, or almost exclusively, noticed. He adds that, "in general, the suffusion is caused by the basal extension of the outer row of spots on the upper surface of the front wings, which fill the whole breadth of the interspaces, often barely showing a line of tawny scales along the intervening nervules. In the most extreme cases there is a slight expansion externally, so as to approximate the broad dark band formed by the suffusion to the marginal band, but most commonly this does not occur, and usually the interspaces are less completely filled from nervure to nervure over the overrun ground, so that each spot is more or less wedge-shaped, the apices pointing baseward, an appearance which gains in effect from the actual narrowing baseward of all but the two lower interspaces in which this suffusion appears. Sometimes, indeed, the suffusion is reduced to a mere enlargement of the spots of the extra-mesial row with a wedge-like tongue thrust a short distance baseward, occasionally farther on one wing than the other; or it may be merely indicated by an enlargement of all the spots in the wing (except the mid-cellular one, which is never affected by this or any other variation), with scarcely, or no, sign of any special longitudinal expansion." Here it is quite clear Scudder combines at least three of our forms—(1) ab. *magnipuncta*, the spots enlarged, but not specially lengthened; (2) ab. *kochi*, the spots enlarged longitudinally, and forming a transverse series, without, however, any uniting with the discal spot; (3) ab. *extensa-conjuncta*, also enlarged longitudinally, and, in addition, those outside the discal spot extended sufficiently to become united thereto.

λ. ab. *centriconjuncta*, n. ab.—The spots of the submarginal transverse series of the forewings enlarged and moved up closely to the discoidal spot, and united directly therewith and with each other, forming a large and central seriated blotch across the middle of the wing.

Such an example is stated by Barrett to be in the "Webb" collection; he notes it as having "the entire centre of the forewings occupied by a broad, deep, black band of coalesced spots." In this aberration, instead of the discoidal spot being of normal size, to which the spots directly outside are joined by their slender, extended, points, as is the case in *extensa-conjuncta*, the outer discoidal spot itself forms part of the enlarged fasciated band, often placed quite near the middle of the wing. Whether Scudder's most extreme form belongs here or not, is doubtful, but, as he makes no mention of the discal spot, one must assume it to be present; at any rate, it cannot be the extreme ab. *fasciata*, in which the outer discal spot is lost. Maynard observes (*Butts. New Engl.*, p. 41) that, "in some New England specimens, the margin is greatly widened, and the spots elongated, so as to form, with the first spot in the central cell, a large black patch. In these examples the spots on the underside are considerably enlarged."

*μ*. ab. *fasciata*, Streck., "Butts. and Moths Nth. Amer.," p. 101 (1878); [? Scudd., "Butts. New Engl.," ii., pp. 1000-1, *in part* (1889);] South, "Entom.," xxvi., p. 305 (1893). *Phlaeas* var., Weston, "Entom.," xi., p. 25 and fig. (1878). *Fasciatus*, Ckll., "Entom.," xxii., p. 99 (1889); "Ent. Rec.," i., p. 320 (1899); ix., p. 331 (1897).—♀. All the black spots on the uppersurface of primaries, save one within the discoidal cell, are enormously enlarged and confluent, forming a broad, somewhat irregular, black band extending from costa to the inner margin. Undersurface exactly as in common form. Florida (Strecker).

The character of ab. *fasciata* by which it is to be distinguished, is that all the spots on the upper surface of the forewings, except the one in the cell further towards the base, unite to form the central transverse band. The outer discal cellular spot is lost by union with the transverse series, the members of which are enlarged and moved towards the centre of the wing. This character is excellently shown in the figure in the *Entom.*, xi., p. 25. As we have just observed (*suprà*), Scudder describes (*Butts. New England*, ii., pp. 1000-1001) as *fasciata*, certain specimens in which, "in the row of spots in the outer half of the wing, each spot, though perfectly distinct from the others, is expanded a very little exteriorly, and very much interiorly; the spots beyond the cell joining that which borders the outer limits of the same; those in the median interspaces extending nearly, or quite, to the base of the interspaces, and that of the medio-submedian interspace, in one instance, as long as broad, and in the other twice as long as broad, instead of being, as normally, half as long as broad. On the undersurface, the wings have the normal pattern," etc. This form clearly is not the true *fasciata*. It is remarkable that the true *fasciata* form was renamed, quite independently, by Cockerell, who applied the same name as had Strecker, to the fasciated insect described and figured by Weston (*Entom.*, xi., p. 25). This figure has all the spots comprised in the transverse submarginal row of the forewings concentrated into a thick continuous transverse band, stretching across the wing, the discoidal spot being entirely absorbed therein; the hindwings marked as usual; the markings on the underside entirely normal, without showing the slightest trace of the black band so conspicuous on the upperside. The specimen was taken at Finchley, August 7th, 1876. Hodge notes an example with the spots of the forewings confluent, resulting in a rather distinct crescent-shaped mark on each forewing, taken at Eastbourne, July, 1881. Lusby captured a specimen at High Beech, with the black marks on the forewings forming a group in the centre of the disc. Harwood (*Vict. Count. Hist. Essex*) says that black-banded examples have been found at various times on the coast of Essex. South observes (*Ent.*, xxvi., p. 305) that we sometimes find examples with the spots much larger than usual and often tending to confluence. The extreme limit to this phase, he says, in the variation of this insect, "appears to be reached in var. *fasciata*, Strecker; in the *Entom.*, 1878, p. 25, is a figure of a banded example of *C. phlaeas*, taken in Middlesex, which is certainly the form described by Strecker," and he adds that "intermediates between var. *fasciata* and the type are not rare in Britain; Mr. Sabine captured three examples this year, in all of which the black spots are very large, and those of the transverse series inclined to coalesce; the outer discal spot in one example is almost united with the fourth spot of the transverse series; in another specimen, the third and fifth spots of the transverse series are pyriform."

ν. ab. *latomarginata*, n. ab.—The black outer marginal border of the forewings considerably extended towards the centre of the wings.

Clark observes that he has a specimen, from Abbott's Wood, with a broad, black, hindmarginal band to the forewings, reaching to, and including, the transverse row of spots. Bromilow records that an exaggerated form was taken on the French Riviera, at Caussols, on August 7th, 1893, in which the dark hindmarginal border of the forewings was twice as broad as in the usual *eleus*, and was jet-black, the copper colour, too, of all the wings being of a fiery-red; on the hindwings there were no traces of the row of blue spots which are sometimes present. Imms notes that the ♂s taken in Sutton Park often have the coppery colour much intensified, and the black edging of the wing considerably widened. Kane also says that specimens with broad hindmarginal black bands and large spots, are occasionally taken in Ireland. We have an exceptionally broad-bordered example of the *suffusa* type, with the nervures also strongly outlined in black, and the spots of the submarginal row of large size, taken at Bobbie in mid-August, 1901; also large ♀s taken in Malta, July 17th, 1897, with broad outer margin, large spots, and also tails to the hindwings, etc.

ξ. ab. *nigroapicata*, n. ab.—Having a broad black band extending all along the outer margin of forewings, and much intensified at the apex, where it runs inwards, enclosing the three black spots there situated. A very fine form (Raynor collection) taken by Harwood at Colchester, August 2nd, 1906.

This form might be, perhaps, added to the melanic series, but as it only involves the band and apex, and the ground colour is not influenced, it may be maintained here.

ο. ab. *melanophlaeas*, Vill. and Guén., "Tab. Syn. Lép.," p. 36 (1835); Obth., "Études," etc., pp. 13-14, pl. v., fig. 76 (1896).—Differs only from *phlaeas* in that the forewings are entirely brown, and only lightly powdered with golden-tawny (fauve-doré) at the base; the hindwings with the whole or part of the antemarginal tawny band also sometimes obliterated. South of France, also near Paris. This is possibly only an accidental aberration of *phlaeas*, but it is frequently found; we have taken it near the Bois de Boulogne (Villiers and Guénee).

This is really a combination of ab. *latomarginata* and *fasciata*, in which the margin is largely increased, the transverse row of dots elongated, the discoidal spot also elongated, the whole resulting in a suffusion of the greater part of the forewing. Oberthür says that black shades, or streaks, obscure the whole of the anterior part of the forewing; and that his fig. 76, taken in the Bois de Boulogne, near Paris (from the Bellier collection), represents this form, called *melanophlaeas* by Villiers and Guénee. The Boisduval collection contained another, absolutely similar. He adds that "it must not be confounded with *turcicus*, Gerh., with which, however, it might be linked by transitions." It is also recorded from Biarritz by Rondou.

π. ab. *basilipuncta*, n. ab.—Forewings with an additional black spot in the discal cell towards the base. ♀, Tintern, August, 1906; captured by J. F. Bird.

### Variation in markings of hindwings.

α. ab. *caeruleopunctata* [Staud.,] Rühl, "Pal. Gross-Schmett.," p. 218 (1895); Tutt, "Brit. Butts.," p. 153 (1896); Wheeler, "Butts. of Switz.," p. 19 (1902). *Phlaeas* var. δ, Stphs., "Illus. Haust.," i., p. 80 (1828). *Coeruleopuncta*, Strand, "Nyt Mag. f. Natur.," xl., p. 163 (1902).—A row of small blue spots, varying from one to five in number, and from a single scale to a fairly large spot in size, situated just within the inner edge of the coppery-red submarginal band of the hindwings.

Rühl refers the name to Staudinger, with the diagnosis "having very bright and numerous blue spots on the hindwings. Central

Asia." We cannot discover that Staudinger described this form. It is the var. δ of Stephens who diagnoses it as having "the hindwings more or less spotted with blue towards the coppery band." This form, with a row of blue spots just inside the coppery outer marginal band of the hindwings, appears to be frequent in all the races of the species found in the Old World. We have already quoted (*anteà*, pp. 334-335) Weismann's remarks thereon, and also Chapman's (*anteà*, p. 340), and we may here note that, in addition to the eastern Asiatic races, Nicéville observes (*Butts. of India*, p. 317) that, in India, the var. *stygianus* usually has a series of 4 or 5 pale blue hastate spots, directly above the inner edge of the coppery hindmarginal band of the hindwing. They are also shown very strongly in Cramer's figure of *timeus*, from Smyrna. In Europe, examples are recorded from Scandinavia, Germany, Austria, Switzerland, France, Italy, and Spain, and it is very frequently observed in the British Isles. We note that, on April 20th, 1903, at Locarno, almost all the specimens had a very strong marginal series of red spots on the underside of the hindwings, and a row of blue spots just inside the hindmarginal band on the upperside (an example is reproduced in our pl. xiii., fig. 3), and, in our own collection, we particularly note the blue dots in the spring form from south France and the Riviera, Digne, Cannes, Auribeau, Hyères, and Albenga, in both sexes. The summer brood of Susa only shows the spots in a small proportion of specimens, although, in one example from here, there are some scattered blue scales, not only in the ordinary position, but also nearer to the base; they often occur in specimens of the summer brood taken at Aosta, Torre Pellice, Crissolo, and also in the same brood at St. Michel-de-Maurienne, St. Jean-de-Luz, Arcachon, as well as on the Petit St. Bernard and the slopes of the Brévent in August, where the species is probably only single-brooded; in Switzerland, examples with blue spots have been taken also, in August, in the Saas-Thal, etc. The Malta specimens (March and August), and those from Beyrout (May) are also well-marked in this direction. They are almost entirely absent in Spanish examples, the ♀s only occasionally showing one or two small blue points, a ♀ from Bejar, taken in July, 1902, is the best in our Spanish series. They are also unaccountably absent in a long series taken in Fontainebleau Forest in mid-August, 1899. Of the Scandinavian examples, Strand observes that, of some 108 examples taken in Suldal, in 1901, 57 belonged to the form which has blue spots on the inner side of the marginal band of the hindwings; in most of these examples, these spots are only weakly developed, sometimes scarcely visible without a lens; in 51 they are absent. From this, Strand concludes that about one-half of the individuals of the second brood (to which all his captures belonged) are of the blue-spotted form. Schneider, in his account of the Tromsö *phlaeas*, says (*Troms. Mus. Aars.*, xv., p. 20) that, here, the blue spots along the hind-margin of the hindwings are often strongly developed, and this is particularly noticeable in most ♀s, while they are often entirely wanting in the ♂s. Chapman notes the examples at Bodö as being very bright in tint, and with blue spots on the hindwings; and those in our collection, taken at Bossekop, 1897, are particularly well-marked. The aberration is common in Britain, although South asserts that the blue spots are rarely, if ever, so large and conspicuous in British examples as they are in specimens from eastern Asia. They are frequently mentioned in

records of the capture of the species, *e.g.*, Bird notes that specimens are quite common, with from two to five spots, at Tintern; Rait-Smith, that they are common at Abertillery; Carpenter, that they were present in almost all the specimens of a brood reared from eggs laid by a ♀ taken at Abbott's Wood; Sabine, that they are frequent near Dartford; he captured an example in October, 1901, with unusually large blue spots, whilst in July, 1903, from the same district, he bred "two dark copper-coloured examples, tinged with purple on the basal half, one of the latter with rather large blue spots on the hindwings." Beadle records them from Keswick, and we have a long series (17) taken at Deal, in August, 1887, showing the range of spotting in the specimens taken that year, and extending from a single scale to four well-developed blue spots. Raynor observes (*in litt.*): "I have two specimens, each with four faint blue spots, bred from eggs found at Brentwood, August, 1891; also similar specimens caught at Colchester, September, 1900, and Hunstanton, August, 1899, one with three blue spots at Hazeleigh, September, 16th, 1901; several with two blue spots each at Hazeleigh; and one, with six blue spots, very large and beautiful, taken in north Kent by L. W. Newman, August, 1903, is in my cabinet." Dalglish notes its occurrence at Inverglas, September 13th, 1895. Kane observes that examples with more or less blue spots on the hindwings occur in Ireland, and Lowe that the blue-spotted form is frequent in Guernsey. Lambillion states that it occurs occasionally in Belgium. Standen notes that, at Vizzavona, in Corsica, an exceptionally fine form occurs, many of which show a beautiful series of blue dots on the inner margin of the copper band of the hindwing. Lang observes that the dark form that occurs at Gibraltar has frequently a row of more or less distinct purple spots between the base and the marginal copper band on the hindwings. In Germany, it is not often mentioned, although Gillmer says (*in litt.*) that it is common, occurring almost everywhere with the type; it is, however, recorded as occurring near Schwerin and Parchim (Gillmer), and also as found in August along the railway-bank from Hanau to Friedberg (Limpert and Röttelberg), etc. In France, it is noted as occurring in the Hautes-Pyrénées—Gèdre (Rondou), Var—Hyères (Rowland-Brown), whilst R. F. Brown, writing from the Bordeaux district (*Le Nat.*, 1880, p. 180), observes that a small percentage of his captures are spotted with blue, all, however, ♀s. It would appear to be a less frequent aberration in North America, and Mansbridge notes (*Proc. Sth. Lond. Ent. Soc.*, 1894, p. 124) that the examples taken in the "Indian Territory," North America, had no blue spots on the hindwings, otherwise they were like British specimens. The aberration is found in almost all the described forms, so that we may have ab. *fasciata-caeruleopunctata*, ab. *eleus-caeruleopunctata*, var. *timeus-caeruleopunctata*, ab. *obsoleta-caeruleopunctata*, etc.

β. ab. *cupreopunctata*, n. ab.—With the row of little blue spots frequently found on the inner edge of the coppery-red hindmarginal border of the hindwings, replaced by little coppery-red spots.

Of this form, Sabine records the capture of examples in September, 1899, in the Erith district (*Ent.*, xxxii., p. 284).

γ. ab. *subradiata*, n. ab. *Phlaeas* var. ε, Stphs., "Illus. Haust.," i., p. 80 (1828).—With delicate copper-coloured streaks, extending for a short distance along the nervures from the hindmarginal copper-coloured band towards the base.

This form must not be confounded with ab. *radiata*, in which similar delicate streaks replace the hindmarginal band, the latter itself being obsolete; in this aberration the band is present, and the fine streaks commence on its upper edge, and then run for a short distance in the direction of the wing-base, as in ab. *radiata*. Sabine records the capture of an example in October, 1901, near Dartford, with the black before the band on the hindwing delicately streaked with copper-colour. It is the var. ϵ of Stephens, who describes it as having the hindwings with faint radiating coppery lines as in the ♀ of *C. dispar*. We have examples from Cuxton, August, 1881, and the South Foreland, August, 1890, both ♀ s, and the latter with traces of blue dots. Among our continental captures we note specimens from Albenga, April 13th, 1903; Locarno, April 20th, 1903; the Petit St. Bernard, August 3rd, 1898, etc., so that it is possibly well distributed.

δ. ab. *radiata*, Tutt, "Brit. Butts.," p. 153 (1896); Wheeler, "Butts. of Switz.," p. 19 (1903). *Phlaeas* var., Nich., "Ent. Rec.," iv., pl. D, fig. 6 (1893).—With radiating wedge-shaped lines of copper-colour, passing up from the outer margin towards the base, and taking the place of the usual submarginal copper-coloured band (Tutt).

We reproduce in our pl. xiii., figs. 11-12, a ♂ and ♀ of this form. The earliest example of which we have record is noted by Davis as having been captured in April, 1865, the usual copper-coloured margin of the hindwings being in this specimen absent, and only represented by three, short, faint, reddish streaks at the extremity of the nervures, and a minute spot of the same colour at the anal angle. Adkin notes the capture of a specimen at Eastbourne with the copper band of the hindwing represented by five narrow streaks on the wing-rays, the rest being obliterated by the black colour; another in which the copper colour is visible only on one wing-ray near the anal angle. Both examples have the row of blue dots that are occasionally present in the species, and, in both, the undersides are normal (*Proc. Sth. Lond. Ent. Soc.*, 1889, p. 129), so that each forms a combined *radiata-caeruleopunctata*. Hamm also records (*op. cit.*, 1894, p. 39), an example with the band so interrupted as to form a regular series of marginal streaks. Miss Sotheby describes a specimen, also taken at Eastbourne, without the usual copper-coloured band, but having a red pencil-like mark in lieu thereof. Sabine records the capture, at Erith, on September 9th, 1896, of an example of normal colour, but with the marginal band of the hindwings only represented by slight streaks. He also notes (*Ent.*, xxxii., p. 284) the capture, in September, 1899, in the Erith district, of seven or eight specimens without the red band of the hindwings, but having from one to five red pencil-like streaks in place thereof. The example of this form, figured *Ent. Rec.*, iv., pl. D, fig. 6, was taken at Walthamstow by Jackson. Oberthür notes (*Études*, 1896, p. 13) that he has a ♂ and ♀ with the nervures marked by a golden streak, thus making a transition between ab. *obsoleta* and the type.

ϵ. ab. *obsoleta*, Tutt, "Brit. Butts.," p. 153 (1896); Wheeler, "Butts. of Switz.," p. 19 (1903). *Phlaeas* var. ζ, Stphs., "Illus. Haust.," i., p. 80 (1828). *Phlaeas* ab., Obth., "Etudes," etc., p. 13, pl. v., fig. 77 (1896). *Extincta*, Fuchs, "Jahrb. Nass. Ver. Nat.," pp. 120, 121 (1899).—The form in which the red marginal band of the hindwings is altogether obsolete (Tutt).

This is the extreme form in the direction of the loss of the copper-

coloured marginal band on hindwings. It is the var. ς of Stephens, who diagnoses it as having "the posterior wings above totally of a dusky colour, without the cupreous marginal fascia, the specimen here described having been taken on Wimbledon Common in April." Nussey exhibited an example with hindwings entirely of a dark fulvous-brown hue, at the meeting of the South London Entomological Society, held August 25th, 1892 (*Ent. Rec.*, iii., p. 215). Rait-Smith records the capture, at Abertillery, of an example without the red band on the hindwings, and Frohawk notes, taking one on Sussex downs, on July 28th, 1899, without the usual copper band on the hindwings. Intermediates of various stages occur, besides ab. *radiata* (*suprà*). Adkin records one taken at Eastbourne, with the copper band of the hindwings all but obliterated. Clark exhibited, in November, 1890, at one of the meetings of the City of London Entomological Society, an example with black hindwings, and another, taken in May, 1890, on the downs near Brighton, in which the copper band on the hindwings is reduced to a couple of small spots. Still observes that, in 1893, the specimens taken in low-lying parts of Dartmoor, were almost black, with no red showing at all on the hindwings. Prout notes an aberration, taken in the Isle of Wight, in August, 1901, much suffused with dark colour, especially at the outer margin of the forewings, and on the hindwings, only a very small patch of red colour remaining at the inner angle of the latter. Barrett appears to connect this with ab. *obliterata*, although this is not our experience. He says: "In another recurrent and apparently local form, the hindwings are entirely black or nearly so, the marginal coppery band being partially or wholly obliterated; occasionally, in such specimens, the majority of the spots in the forewings are obliterated, and, in some cases, the margins broadly blackened." This possibly refers to the single example taken at King's Lynn, and described (*Ent. Mo. Mag.*, xxv., p. 83) which had "the hindwings entirely black, the forewings very broadly margined, and the usual row of black spots nearly obsolete." The ab. *obsoleta* is the form figured by Oberthür, in 1896, and described as being "absque vitta marginali rubro-aurea," the figure being made from a British example from the "Howard-Vaughan" collection. He notes (*Études*, 1896, p. 13) that "the marginal golden-red band of the hindwings has disappeared," that he possesses "six other examples besides that figured, all from England, whilst one ♀ of this form also possesses the little series of blue spots which is sometimes present above the fiery-golden submarginal band," a combination of *obsoleta-caeruleopunctata*. Fuchs notes (*Jahrb. Nass. Ver. Nat.*, 1899, pp. 120-1) that he caught, on July 13th, 1887, on the Roesling mountain, a ♂ in which the normal copper-coloured band on the hindwing is obsolete both on the upper and undersides, so that the tailless hindwings are uniform grey-brown above. . . . . This hindwing aberration, he says, can be designated as *extincta*. Of course, the name falls before *obsoleta*.

### Variation due to suffusion of ground-colour.

Reference to Weismann's remarks (*anteà*, pp. 331-333) will show that *eleus* has been used in so general a manner as to include all the different southern suffused examples, independent of their special characters, or the amount of suffusion. By many lepidopterists it has (including ourselves) been referred to as "the southern race,"

whilst Mrs. Nicholl records "black specimens of *eleus*, July 9th, 1898, at Blagaj, in Bulgaria. Chapman has attempted (*anteà*, p. 338) to meet this difficulty by showing that *eleus* has been used in two senses, first, aberrational (the darkest form of *phlaeas*); secondly, variational or racial (as the dark southern race), but it is quite clear that, although this is so, Fabricius, originally, merely described a suffused example from Germany as *eleus*, and the usage of the name in a varietal or racial sense is due to recent writers, and one is unable now to unravel from the records of *eleus*, those that refer to (1) slightly suffused and tailed forms, (2) slightly suffused and untailed, (3) much suffused, tailed, and (4) much suffused, and untailed, forms. If such a racial name has any standing, it certainly should be Zeller's *aestivus* (see *infrà*). Throughout southern France, northern Italy, Spain, the Balkan peninsula, Asia Minor, and Syria, as well as along the whole of the north of Africa, from Egypt to the Canaries, the summer brood varies in degree from practically typical to almost black, the specimens, however, as a whole, being markedly suffused, compared with the spring forms, and some districts producing a markedly larger proportion of dark specimens than others. In 1865, Lucas noted (*Ann. Soc. Ent. France*, p. 499) that "the examples from the south, and even from the centre, of France, have the upperside of the forewings more browned, whilst, in the ♀s, the hollowing of the outer border of the hindwings is very pronounced, forming, in a way, two small tails." It is remarkable, however, how bright are the spring (March-May) forms along the French and Italian Riviera—Albenga, Cannes, Auribeau, Agay, Hyères, and even at Draguignan and Digne—the examples being quite as pale as our own spring examples and with even smaller dots, and the costa being quite free from any suspicion of shading or suffusion; they are very different from the April and May specimens taken in the Italian lake district, at Locarno, where the ground colour is much redder, the spots extended into the *juncta* form, and united with the outer marginal band by black nervures, the costa also slightly suffused, yet, in the Riviera, the summer brood is especially dark, suffused examples from the end of June onwards largely replacing the pale typical forms of the spring. Even as far north as Fontainebleau there is some suffusion in the August brood, whilst at St. Michel-de-Maurienne the suffusion is most pronounced; very dark too, and well-tailed, are the specimens from Arcachon, much more so than those from St. Jean-de-Luz in the same district. In Piedmont there is considerable admixture of forms in the summer broods, some of the August specimens at Susa being almost typical, others quite dark, and but few particularly well tailed, whilst at Torre Pellice and Bobbie the ♂s are well suffused and tailed, and most of the ♀s are almost typical, the darkest ♂ in our collection from this part of Piedmont coming from Crissolo, at the foot of Mont Viso. Forbes, comparing specimens captured from mid-August to mid-September, 1876, in the Italian lake district (Bellagio, Pallanza, etc.), with others from England, says (*Ent. Mo. Mag.*, xiii., p. 243) that "the Italian specimens have the markings less distinct, the copper-colour redder, the spots smaller, the costal margin of the primaries darker, and the marginal band broader than any English examples examined. The underside of the primaries, too, is redder, leaving the circumscription of the eyes and the veins of the wings paler."

Lowe, writing of the May and June insects from the same district (Orta Novarese), in 1900, observes that they were of "quite usual forms, except that an occasional ♀ was taken with a great increase of the caudation of the hindwings, and much suffused with black, apparently var. *eleus*." The Spanish summer examples from Cuenca, Moncayo, Bejar, Avila, Albarracin, etc., are very characteristic—on the whole dark, the ♂ s well tailed, the spots of the submarginal series on forewings united, the nervures dark, but particularly are they noticeable for the absence of blue spots, scarcely any ever being present in the Spanish ♂ s, and very rarely even in the ♀ s, the latter, though usually tailed, have a much more typical copper coloration than the ♂ s. Of the variation of this species, in its still more southern localities, there are many interesting records. Zeller, in 1847, wrote (*Isis*, xii., p. 39) of the Sicilian examples:

"α. *Vernus*: alis anterioribus laete igneis, margine nigricante angustiore, posteriorum margine vix unidentato.

β. *Aestivus*: alis anterioribus igneis nigrofumatis; posterioribus subcaudatis.

During the warmer months the species is very common everywhere in Italy, and I found them most abundantly in the villages on Etna, even beyond the forest region, on the flowers of *Senecio*, so very plentiful there. I caught the first specimen, a beautiful ♀, in the mountains near Messina, on February 15th, the first brood lasting till the end of May; the beginning of June ushered in the beautiful second brood, distinguished by its much more splendid pure fiery tint, like that which characterises the German specimens flying in May and June, and usually those occurring in summer and autumn also; on the forewings the blackish band is narrow, the black dots small; on the hindwings the orange-red band is remarkably wide, and the hind-marginal angle of the first branch of the median nervure hardly even slightly prominent. This brilliant colour is lost in the hot summer months. The black outer margin of the forewings then becomes wider, reaches up to the spots, often overlaps them, and loses itself as a cloud or shading, which darkens the most radiant part of the wing, the basal third. This darkening is more marked in some specimens than in others, and more complete in the ♂ than in the ♀, and such areas as are not absolutely covered lose their vividness and lustre, particularly the areas directly before and behind the discoidal spot, which are never completely covered. The black spots are generally large, mostly without sharp outlines, and of a deeper black in their centres than on their edges. On the hindwings the red band narrows and shortens, whilst the hind marginal spots enlarge and encroach still more on the band. The anal angle, however, is enlarged and frequently develops into a small conspicuous tail into which the red colour of the band throws a small tooth, whilst at its tip are blackish hair-scales intermixed with a few whitish ones. On the underside the different generations agree, only those examples that have the darkest upperside, have the underside of the forewings pale, whilst small light blue scales before the red band of the hindwings are rare; they occur, however, in both generations. I have already noted (*Isis*, 1840, p. 128) that dark *phlaeas* occur in Germany" (see *posteà*). Fletcher says (*Ent.*, xxxviii., p. 318) that, in Malta, "the species is abundant, and occurs throughout the year, although, of course, only occasional examples are to be met with in the winter

months. Early spring specimens are typical, but the hindwings beneath are generally greyer than in the north European form; those found from May onwards are referable to *eleus*." Mathew says that the insect occurred in December, 1896, January and February, 1897, and it was swarming when he returned to the island in July, 1897, the specimens then being "large and dark, of *eleus* form." He further notes that, "in Turkey, the insect is abundant at Gallipoli, Constantinople, Salonika, and on the Asiatic shores of the Gulf of Ismid, Sea of Marmora, and Dardanelles. Examples taken in spring and early summer are usually similar to those obtained in England, but, in late summer and autumn, they are mostly the dark form *eleus* of Fabricius. At the island of Pachalimon, in the Sea of Marmora, on June 17th, 1878, a very hot day, this variety was met with in great abundance, and they were such an extremely dark form that it gave the idea, at first, that it was a new species. The island is full of deep little ravines running from the interior to the beach, and here these butterflies had congregated in immense numbers to shelter from the intense heat, and I often had more than a dozen in my net at a time (*Ent. Mo. Mag.*, vol. xviii.). In Gibraltar, he adds, it occurs throughout the year, the early forms typical, the summer specimens dark and of the *eleus* form; so also in Crete and Corfu, and this is probably the case in all the Mediterranean littoral localities." Walker similarly notes (*in litt.*) that, "on both sides of the Straits of Gibraltar, Malta, Sicily, Tangier, etc., the species occurs all the year round, the specimens taken from late autumn to April being exceedingly like our ordinary summer specimens, perhaps rather warmer in tone on the hindwings beneath, whilst those taken in June and July are very pronounced *eleus*, some with very little of the copper-colour remaining, the ground-colour being almost entirely suffused with black. I think the summer specimens are even darker in Malta and Turkey than in Gibraltar." Nicholson observes (*Ent.*, xxvii., p. 118) that "the Corsican examples come close to *eleus*, but do not exhibit the tails quite so conspicuously as the true *eleus*, and are considerably blacker than *eleus*; moreover, they do not appear to be temperature forms like *eleus*, but rather a well-marked local race. They occur throughout the season, and at various altitudes, the majority of the specimens examined coming from the slopes of Pointe Ceppo, just above Vizzavona, where the mean temperature would be decidedly below that of the south of England." Mathew observes (*in litt.*) that "examples captured in Madeira and Teneriffe in the spring, are a trifle larger and brighter than English specimens, but, at Madeira, in the fall of the year, I have seen them almost as dark as var. *eleus*." Mrs. Holt-White (*Butts. of Teneriffe*, p. 42) says that "some specimens have been found much darker in colour than those described, the difference being so great as to suggest the possibility of a distinct variety." Bethune-Baker notes (*in litt.*) that, "in June, at Guelma, in Algeria, the specimens were *eleus* with large spots, the hindwing below very soft and pale with evanescent markings. The Asia Minor examples vary considerably, those taken in Brussa are very dark." Of the latter he has a series of some 20 specimens taken in June, July, and September, and he says that these are the darkest he has, "the copper, when visible, pale in colour, the spots suffused and large, the spotted band on the primaries largely confluent. In three specimens there is

no trace of copper at all on the forewings, but, on the hindwings, the terminal band is deep red, and the tails long for the species; in most of the specimens from this place the tails are prominent. Two examples from the Taurus mountains scarcely differ one whit from our English ones." Swinton says that, "at Jerusalem, the dusky Mediterranean form of *phlaeas* occurs, with the tails of the hindwings more or less long."

The suffused or melanochroic forms of this species may be grouped as follows:—

1. The ground colour slightly suffused along the costa, the inner margin, and the outer portions of the nervures (sometimes extending inwards, almost to the base); hindwings without tails = ab. *initia*, n. ab.

1*a*. As in 1, but the hindwings markedly tailed = ab. *initia-caudata*, n. ab.

2. The ground colour of forewings suffused, leaving the discal area still fulvous; hindwings with fulvous marginal border, but not markedly tailed = ab. *suffusa*, Tutt.

2*a*. As in 2, but the hindwings markedly tailed = ab. *eleus*, Fab.

2*b*. The fulvous colour confined to a narrow, longitudinal stripe of the forewing extending from base to outer margin, and including the discal spots; hindwings markedly tailed = ab. *turcicus*, Gerh.

3. The ground colour of forewings entirely suffused with blackish-brown, including the discal area, through which the fulvous tint shows only feebly; hindwings with fulvous marginal border, not markedly tailed = ab. *fuscata*, n. ab.

3*a*. As in 3, but the hindwings markedly tailed = ab. *fuscata-caudata*, n. ab.

Dealing with these in more detail we find much interesting information, difficult, however, sometimes to refer to its own particular form. Our notes on the melanic aberrations read as follows:

α. and β. abs. *initia*, n. ab., *initia-caudata*, n. ab.—The costa slightly suffused, the nervures darkened, the inner margin towards the base with brown suffusion. The ab. *initia* without, the ab. *initia-caudata* with, tails to the hindwings.

Both these forms are fairly common in the summer brood of this species, in Britain as well as in central Europe. They form the first step in the direction of the more markedly suffused forms, the suffusion first showing itself faintly along the costa, along the nervures, and along the inner margin towards the base of the forewings. Where the darker forms occur in the south as frequent aberrations, these also occur and look almost typical by comparison, so slight is the suffusion.

γ. ab. *suffusa*, Tutt, "Brit. Butts.," p. 153 (1896); Speis., "Berl. Ent. Zeit.," p. 135 (1902); Wheeler, "Butts. Switz.," p. 18 (1903) *Transiens*, Fuchs, "Jahr. Nass. Ver. f. Nat.," p. 120 (1899).—The ground colour coppery-red, suffused with black, the markings as in the type. Throughout central and southern Europe, etc., chiefly in the examples of the summer and autumnal broods.

This is the form in which the coppery-red ground colour is very appreciably present, but, instead of maintaining its usual brightness, the colour is distinctly suffused with darker scales. Like *eleus*, it is brighter in the discal area of the forewings than elsewhere, this area extending downwards, slightly beyond the submarginal row of spots. The suffusion is most marked along the costa, along the inner margin, over the basal third of the wing, and along the whole of the nervures, but more particularly towards the outer margin. It is not markedly tailed as in ab. *eleus*, although the anal points are sometimes slightly developed in this direction. It is possibly the darkest form usually obtained in Britain, and probably includes most of the British and German examples recorded under the name *eleus*. We have taken specimens at Deal, August, 1887, Cuxton, August, 1893, and July 6th, 1898. James

observes the capture of some specimens, between July 31st and August 3rd, 1900, in the Deal district, that were uniformly dark and dusky, some being very extreme. [James adds that the heat was excessive in mid-July, in 1900, at the time when these examples would have been in the pupal stage.] Still observes that, on Dartmoor, the examples taken in lowlying situations are darker than those found on the open moor, and that those taken in 1893, in spite (!) of the great drought, are almost black, with no red showing at all on the hindwings (ab. *obsoleta*). Barrett observes that the suffused is a recurrent form, occurring most frequently on open heaths, in Britain, several smoky suffused specimens sometimes being taken about the same spot; quite a little colony of such were found by Mrs. Fraser in a hollow of a hill-side, forming part of a heath on the borders of Surrey; he also records (*Ent. Mo. Mag.*, xxv., p. 83) others of the same form, taken on a boggy bank near King's Lynn. We have found this, perhaps, the commonest form in the valleys of southeastern France and northern Italy in July and August, *e.g.*, at Susa, between August 11th-20th, 1897, the species varied much in tint, some specimens (chiefly females) were quite bright in tint, others intermediate, suffused more particularly on the costal margin and base of the forewings, leaving the discal area still brightly fulvous, others were suffused all over, with the copper colour, however, showing faintly before and beyond the discal and submarginal spots, but yet appearing as quite dark specimens. It is difficult to separate those records of little suffused examples from those rather more so, although Rühl's *turanica* is described as intermediate between the type and var. *eleus*, and Fuch's *transiens* also is similarly described. *Transiens* certainly falls within our *suffusa*, but *turanica* appears to be a special Asiatic form presenting both upper- and under-side variation racially. Fuchs observes that his *transiens* has the colouring of the upperside of the wing approaching *eleus*, *i.e.*, golden-brown, with plentiful black dusting between the branches of the median nervure, but never exhibits the anal tail of *eleus*, the most marked examples never showing more than a faint indication thereof. He notes, however, that it is found only in the summer brood, the spring and late autumnal specimens in the mid-Rhine district being quite normal. He further records the capture on July 13th, 1887, in the Riesling mountain, where *transiens* occurred, a specimen with the fulvous band of the hindwings obsolete, the forewings tending in tint to *eleus*, but each with a central spot as transparent as glass. Speiser notes that, in east Prussia, the majority of the examples of the second brood, in warm seasons, differ from the typical specimens by the more or less strongly suffused ground colour, and he notes that such form a transition to the var. *eleus*, which, however, is also tailed on the hindwings. Real *eleus*, he says, are rare in Germany, although occasional examples occur, but the darkened form without tails are numerous. Rössler says that the form occurs singly in Wiesbaden; Schumann, that it is not rare in the summer brood in Posen. We have found the form distributed throughout Savoy and Piedmont, though not commonly, *e.g.*, St. Michel de Maurienne, July 29th-August 4th, 1897; at Susa, August 11th-20th, 1897; Torre Pellice and Bobbie, August, 1901; we also have examples captured at Arcachon, July, 1902; Fontainebleau, August, 1899; in Spain, at Avila, July, 1902; Bronchales, August, 1901; and

Moncayo; also occasionally in the Swiss valleys, *e.g.*, Saas-im-Grund, August 7th, 1904, etc.

δ. ab. *eleus*, Fab., "Ent. Sys. Supp.," p. 430 (1798); Heyd., "Cat.," p. 12 (1851); Werneb., "Beitr.," p. 395 (1864); Staud., "Cat.," 2nd ed., p. 9 (1871); Lang, "Butts. Eur.," p. 95 (1884); Kane, "Handbook," etc., p. 31 (1885); Pryer, "Rhop. Nihon.," p. 16 (1886); Leech, "Butts. of China," p. 400 (1893-4); Rühl, "Pal. Gross-Schmett.," p. 218 (1895); Tutt, "Brit. Butts.," p. 153 (1896); Weism., "Entom.," xxix., transl. pp. 30 *et seq.* (1896); Obth., "Etudes," p. 14 (1896); Staud., "Cat.," 3rd ed., p. 74 (1901); Wheeler, "Butts. Switz.," p. 19 (1903); Chapm., "Ent. Rec.," xvi., p. 170 (1904). *Phlaeas* var., Zell., "Isis," p. 128 (1840).—*Hesperia Rusticus* alis emarginatis fuscis; anticis utrinque disco fulvo nigro punctato, posticis fasciola fulva, subtus cinereis nigro punctatis. Habitat in Germania. Affinis certe *H. helle* at omnino distincta. Antennæ fuscæ, albo annulatæ, clava oblonga nigra, apice ferruginea. Alæ anticæ fuscæ disco fulvo nitido, punctis majoribus nigris, subtus cinereæ disco fulvo punctis subocellaribus atris. Posticæ valde emarginatæ et fere bicaudatæ, fuscæ, nitidæ fascia abbreviata, dentata, fulva, subtus cinereæ punctis minutis nigris strigaque postica obsoleta, fulva (Fabricius). British localities.—Essex: coast district (Harwood). Hants: New Forest (Bayne). Kent: Deal, Cuxton (Tutt), Dover district (Pickett). Distribution.—Africa: Morocco—Tangier, etc. (Walker); Algeria—Guelma, June, 1884 (Baker). Asia: Japan (Pryer), Asia Minor—Broussa, August and September, 1903 (Fountaine), Smyrna, Beyrout, Marmarice district (Mathew); Syria—Zebedani, Ain Zahalta, July 10th, 1904 (Graves), Jerusalem (Swinton). Austro-Hungary: pretty general in summer brood — Herculesbad, July 12th-20th, 1900 (Lang). Belgium (Lambillion). Corsica: Ajaccio, May 30th, 1893 (Standen), July, 1899 (Lang), July 12th-24th, 1903 (Rowland-Brown), Tattone, Corte, common July 9th-19th, 1904 (Rosa), France: Fontainebleau (Tutt), Arcachon, early July, 1901 (Chapman), Villefranche (Mathew), Nice, almost replaced type in summer of 1893 (Bromilow), St. Martin Vésubie, July 26th, 1903 (Rowland-Brown), Alsace—near St. Louis (Kundeg). Germany: Prussia—♀ near Lych, August 1st, 1877 (Sanio); Sachsenwald, in hot summers (Laplace), singly near Lüneburg (Machleidt and Steinvorth), rare in Thuringia (Knapp), not rare in second brood in Berlin district (Bartel and Herz), one, July, 1898, near Reuthau, another, August, 1900, on the Sandberge, near Zeisdorf (Pfitzner), once near Grimma, once near Beucha (*Verein Fauna, Leipzig*), ♂ near Regenstauf, July 15th, 1875 (Schmid), near Kempten, on the mosses (von Kolb), rare in hot summers, Baden (Meess and Spüler), in the Wildpark, near Karlsruhe (Gauckler). Greece: throughout the summer—Mesolonghi, June, 1900 (Fountaine), Athens, Salamis Bay, Poros, Platea, Corfu, August 4th-12th, 1897 (Mathew), Navarino (de la Garde). Italy: throughout, in the summer—Sicily (Zeller), Naples district—Camaldoli (Weismann), Capri (Browne), Florence district (Verity), Piedmont—Orta Novarese, June, 1900 (Lowe), Susa, Torre Pellice, Bobbie, Aosta, etc. (Tutt), Gardone, August 1st, 1900 (A. H. Jones), Leghorn, Pisa, Brindisi, Ancona (Mathew). Malta (de la Garde). Scandinavia: second brood, Suldal, Stavanger, August-September, 1901 (Strand). Servia: Belgrade (Tutt coll.). Spain: throughout in summer brood—Andalusia (Staudinger), Moncayo, Bejar, Bronchales, etc. (Chapman), Gibraltar, Algeçiras, San Roque, Balearic Isles—Minorca, August 19th, 1874 (J. J. Walker), Majorca, April 8th-20th, 1906 (A. H. Jones). Switzerland: in the summer brood singly, more frequent in the southern valleys—Val d'Anniviers (Tasker), Bérisal, end of August, 1898, Brigue, August 30th, 1898, Bellinzona, dark and abundant, July 15th, 1904 (Wheeler), Sion, Sierre, Niouc, Visp (Favre), Stalden (Tutt). Turkey: Port Baklar (Walker), Gallipoli district (Mathew), Crete, Isle of Pachalimon, June 17th, 1878, very abundant and very dark (Mathew).

It is generally assumed that *eleus*, Fab., comprises the darkest tailed southern forms. The original description was made from a German example, with fulvous disc to the forewings, fulvous hindmargin on the hindwings, and with the ordinary spots; the ground colour more suffused than the type, but evidently not at all the most extreme form in this direction. Of the German suffused forms, Zeller writes (*Isis*, 1840, p. 128): "The aberration, mentioned by Ochsenheimer (p. 90), flies near Frankfort and Glogau, in July and

August, together with the ordinary *phlaeas*. The fiery colour remains purest on the forewings, before and behind the spot which lies on the discocellular. The brown hindmargin extends almost to the row of black spots. The female, which may be considered as belonging to this variety, has a less broad, brown margin, and besides the above mentioned space, the space between the margin and the row of spots remains pure fiery colour, though darker than usual." Nor must it be confounded with *melanophlaeas*, Vill. and Guén., which, if the figure of Oberthür (*Études*, etc., 1896, pl. v., fig. 76) be trustworthy, has the whole discal area, from the outer margin to the base, suffused with black, the suffusion being brought about by the modification of the spots into elongated longitudinal streaks, which occupy the whole of this area. Staudinger diagnoses it as "supra multo obscurior, al. post. plerumque caudula parva." The form is distinguished from ab. *suffusa* by the tails on the hindwings. Strand notes eight specimens taken August 25th to September 17th, 1901, in the Suldal, which he considers should be referred to *eleus*, F., although some differ but little in colour from typical examples. One suspects that these latter may be referable to ab. *typica-caudata* (*anteà*, p. 359). As to its distribution in Britain little is known.

ε. ab. *turcicus*, Gerh., "Beit. Schmett.," p. 5, pl. v., figs. 5*a* (♂), *b-c* (♀) (1853); Obth., "Études," etc., pp. 13-14 (1896).—The specimens that I figure were sent to me by Bischoff, of Augsburg, as *ottomanus;* from the latter, however, as well as from *phlaeas*, it is to be distinguished by its conspicuously dark coloration (Gerhard).

This aberration is described by Oberthür (*Etudes*, etc., 1896, p. 14) as having "the upper surface of the wings, except the marginal border of the hindwings, which remains golden-red, suffused until it becomes deep blackish-brown, giving the insect the appearance of a ♂ *xanthe* (*dorilis*) from Paris; this form is strongly developed in Syria, Transcaucasia, northwest India, and Japan, and transitional forms are not rare in the Pyrénées-Orientales, Sierra Nevada, and Corsica; one even finds strongly developed *turcicus* near Paris and Rennes, but less frequently than in the south." Our examination of Gerhard's figures (5*a*, ♂; 5*b*, underside; 5*c*, ♀) hardly bears this out. Our notes read; "The ground colour dull coppery; the black parts suffused with brown; the copper very little suffused in ♂, much more so in ♀, the latter having the copper colour confined to a longitudinal stripe running from base to outer marginal band, and including the discal spots, and the 2nd and 3rd of the three topmost spots belonging to the submarginal transverse row that crosses the forewings; the copper band on the hindwings rather narrow and inclining to orange, not bright red. The tails are well produced. The underside of forewings dirty orange, the black spots ringed with white; of hindwing unicolorous reddish-grey, darker on margin, no dots." The form (♀) really differs little from *eleus*, Fab., only it has a band-like streak of copper from base to outer margin, instead of the usual median patch, narrowing basally and widening outwardly. Maintaining the name for this limited form, we have examples from Italy—Susa, August, 1897, Crissolo, August 5th, 1901, Torre Pellice, August 7th, 1901; from France—Arcachon, July, 1902; Spain—Moncayo, Bejar, Avila, July, 1902, Bronchales, early August, 1901; Malta—July, 1897; Syria—Beyrout, Servia—Belgrade, Austria—Orsova, July, 1898;

Bulgaria—the Rilo, May 28th, 1899. Gerhard's representation of *eleus* (pl. v., fig. 3, called a ♂, but looks like a ♀) is a bright coppery-red example, with very faint, and rather small, black spots on forewings, and very wide red hindmarginal band on hindwings; the tails are fairly developed. There is no suffusion shown in this figure, so that his *turcicus* is much nearer the true *eleus*, Fab., than is his so-called *eleus*.

ζ. ab. *fuscata*, n. ab.—The forewings suffused with blackish-brown, including the discal and submarginal areas, through which only a faint suffused tinge of copper appears; the hindwings with copper marginal band and not tailed.

This agrees much more with Oberthür's *turcicus* (*suprà*) than does the latter with *turcicus*, Gerhard. Forms suffused to this extent are always rare, except in the Mediterranean districts. Peyerimhoff notes the occurrence of examples in Alsace with the disc of the forewings entirely suffused with black.

η. ab. *fuscata-caudata*, n. ab.—The whole of the forewings suffused with blackish or blackish brown, the discal area only showing very faintly the position of the copper areas before and beyond the discal spot; the marginal border of the hindwings fulvous; the outer margin tailed as in ab. *eleus*.

This is one of the darkest forms of *phlaeas*, and occurs as a rare aberration in the southwestern parts of its distribution, more commonly in the eastern parts of the Mediterranean area, *e.g.*, the Balkan peninsula, Greece, Asia Minor, Syria, etc. Weismann also notes it as occurring in Corsica. Staudinger's diagnosis of *eleus* (*Cat.*, 2nd ed., p. 9), "caudata, supra nigricans," agrees better with this form than with *eleus*, Fab. His later diagnosis of *eleus* (*Cat.*, 3rd ed., p. 74), "supra multo obscurior, al. post. plerumque caudula parva," although somewhat wider, still fails to note the fulvous discal area of the Fabrician *eleus*. We have examples closely approaching this from Piedmont—Crissolo; Spain—Bejar, Bronchales; Syria—Beyrout; and Corsica—Bastelica.

### Variation of the markings on the underside of wings.

There is considerable variation in the ground colour of the underside of the wings, which extends from pale whitish-grey to warm brown and red-brown whilst the outer marginal band of the hindwings, sometimes quite strongly marked with orange, is, on the other hand, absolutely obsolete in some specimens with every possible intermediate stage in different individuals; similarly, the spots on the underside of the hindwings vary from tiny specks (a mere dusting) to fairly large, strongly marked, well developed, dots. There is also considerable difference in the size of the spots of the forewings, and these are often conspicuously outlined with a pale circumscription. But, apart from this general variation, more marked aberrational forms occur, chiefly in the direction of the extension of existent spots, or by the union of two independent dots by a marked streak. We give illustrations of the most marked of these in pl. xiii., figs. 4, 5, 13, 14. On this subject, Scudder writes (*Butts. of New England*, p. 1001): "The underside of the wings rarely varies to any material extent in American specimens, and the variation is mostly confined to the brief cuneiform extension (but not in any other way enlargement) of the extra-cellular spots of the front wing; but, what is remarkable is that a suffusion (extension) of spots of the upperside of the forewings is often correlated with obsolescence, or almost complete

bliteration, of the extra-mesial spots of the underside, and this seems to be more likely to occur the deeper the suffusion above; in one instance, however, and this the most extreme case of suffusion (extension) of the upperside spots, known to me, not only are the extra-cellular spots of the underside of the forewings much elongated, on one side nearly reaching the cell, but the spot in the lower median interspace is also considerably enlarged, while, upon the hindwing, several of the extra-mesial spots, otherwise of normal size, send shoots towards the base, and the two costal spots are elongated on both wings, and on one actually united into a long sublunate stripe. The same is the case to a less extent in one other specimen, while, in a third, also an extreme case of suffusion above, not only are the spots of the extra-mesial row of the hindwing almost wholly (some of them wholly) obliterated, but on one side both, and on the other the inner, but not the outer of the costal spots, have also disappeared." On the variation of the undersides of some specimens, taken by Sabine, in the Erith district, in 1893, South observes (*Ent.*, xxvi., p. 306) that "the black spots on the primaries are very frequently distinctly ringed with yellowish, but the spots on the hindwings are not well defined as a rule. In some examples, however, the black spots are not only distinct on the hindwings, but these wings have also a black transverse waved line, edged externally with pale greyish-brown." Chapman observes that "the undersides of examples, taken between July 10th-17th, 1898, at Bossekop, were of a much cooler grey tone than in the English form." The most remarkable underside aberration, is one corresponding with our ab. *extensa* or ab. *extensa-conjuucta* of the upperside (*anteà*, p. 363). It has the submarginal row of black dots extended as wedge-shaped marks towards the base (see pl. xiii., figs. 4, 14). There are, of course, intermediate forms between the most extreme aberrations in this direction and the type. The union of the two discal spots of the forewings by a longitudinal line (ab. *disco-juncta*, n. ab., see pl. xiii., fig. 13), and the formation of costal and inner marginal streaks on the hindwings (ab. *infra-radiata*, n. ab., see pl. xiii., fig. 5) are also occasionally met with. The marked streaked forms noted above we would describe as :—

*a.* ab. *infra-extensa*, n. ab., pl. xiii., figs. 4, 14. *Phlaeas* ab., South, "Ent.," xxvi., p. 305, fig. 1 (1893); Buckstone, "Proc. Sth. Lond. Ent. Soc.," p. 109 (1899); Fountaine, "Ent.," xxxvii., p. 137 (1904).—The spots forming the submarginal transverse row on the forewings lengthened, and pointing towards the base of wing.

South figures (*Ent.*, xxvi., p. 305, figs. 1 and 2) two underside aberrations captured by Sabine, at Erith, September 7th, 1893. Fig. 1, our *infraextensa*, shows a form which may be compared with our *extensa-conjuncta* on the upperside. It has the spots of the submarginal row extended in the same manner, the fourth spot from the costa joining the base of the discal cell, the sixth much prolonged, and the seventh enlarged, whilst, on the hindwings, the two costal spots, are united together, forming a costal streak. Buckstone exhibited, at a meeting of the South London Entom. Society (*Proc. South Lond. Ent. Soc.*, 1899, p. 109), an example with the spots on the undersurface of the inner margin of the forewings elongated towards the base of the wings, taken at Beckenham, August, 1886. Miss Fountaine records the capture of a ♀, at Broussa, in August, 1903, which had the submarginal row of black spots on the

underside of the forewings elongated into broad black bands, almost confluent.

β. ab. *disco-juncta*, n. ab.—The two spots in the discal cell joined so as to form a distinct basal lineola. This rare aberration is reproduced in our pl. xiii., fig. 13.

γ. ab. *infra-radiata*, n. ab. *Phlaeas* ab., South, "Ent.," xxvi., p. 305, fig. 2 (1893).—♂. In this aberration, the variation is confined to the undersurface of the hindwings; these have all the black spots well defined, including a large quadrate one about middle of the costa, and an elongate one on the abdominal margin towards the anal angle. Erith (South). This appears to be represented in our pl. xiii., fig. 5.

Teratological examples.—The following are interesting records:—

a. A large ♀ of ordinary type, minus the left forewing, and with the left hindwing suffused much after the style of *C. dispar*. Bred by Sabine, September, 1904 (*Ent.*, xxxvii., p. 285).

β. A large ♀ with the forewings and hindwing on the left side of ordinary type, the right hindwing fully formed but much smaller than the left hindwing, the marginal copper band very wide, and the colour considerably paler than that of the remaining wings. Taken August, 1890, at Deal (Tutt coll.).

Gynandromorphic examples.—The following are the only recorded cases that we can trace of possible gynandromorphic specimens:—

a. There is often considerable diversity in the vividness of colour of different individuals of the same species of butterfly or moth, one being much more beautiful than the other; in the same individual, however, one wing, in general, exactly corresponds with the other, its fellow; but I once took a "small copper" in the month of September, which had a very apparent difference in the colour of the wings, the left forewing being much lighter on both surfaces than the right, though neither was defaced in any degree (Gosse, *Can. Nat.*, p. 220).

Scudder considers this to be a possible case of hermaphroditism. It appears, at least, very doubtful.

β. Left wings ♂; right wings ♀; the antennæ just the opposite, the longer one being on the ♂ side; the wings are very distinctive (Sabine, *Entom.*, xxix., p. 315).

Egglaying.—The eggs are laid on the upper- and undersurface of the leaves of sorrel and on the stems. A ♀ caught in early June, 1905, laid nine eggs on one large sorrel leaf, and eight on the adjoining stem (above the leaf) (Raynor). On September 7th, 1868, I followed a ♀ for more than two hours over a large pasture, and saw her deposit her eggs on plants of sorrel; she did not fly in the usual brisk manner of this species, but only a short distance at a time, and never laid more than one egg on a plant, so that I conclude, the larvæ are solitary; between each two eggs that she laid, she settled frequently on some tall bent of grass or other prominent post, and basked in the sun. Several other ♀s were observed with the following results: The egg was almost invariably laid on the midrib of the leaf close to the stalk; the smaller plants of sorrel were chosen on which to deposit the egg, indeed, sometimes a plant with not more than three or four leaves, and those not larger than threepenny pieces. On three occasions, whilst carefully searching larger plants, I have found two eggs on a leaf, but, in two of these cases, only one egg was laid by the same ♀; I never lost sight of any particular insect I was following, and carefully avoided frightening it. I noticed that the ♀s often settled on the ground, and walked some distance, searching apparently for the sorrel, and, in this investigation, as also in selecting a place on a leaf for the egg, they seemed to make use of their antennæ, which were depressed and passed carefully over the leaves (Farn). Oviposition takes place in the afternoon. The female flutters over *Rumex acetosella*, choosing plants on

banksides, sides of ditches, depressions of ground. It alights on the plant, and, keeping its wings partially opened, it curves its abdomen, and walks deliberately over a leaf with the abdomen pressed against it. When it reaches a suitable place (generally on midrib, near junction of petiole and leaf) it closes its wings with a jerk, deposits the ovum, flies off and repeats the process. The ovum generally is on the upperside, as above described, but I have found ova in nature on the underside, and on the petiole. The ova are laid singly. (I once thought I saw an ovum laid on *Ranunculus repens*, in a ditch, but could not verify) (Harrison). On September 29th, 1895, ♀s were seen busily engaged depositing their ova on dwarf plants of *Rumex acetosella*, and, on examination, a profusion of ova was discovered on them; ova laid July 8th, 1900, hatched July 17th and 18th, all the imagines emerged between August 21st and 28th, 1900 (Prideaux). Hawes notes (*Proc. Sth. Lond. Ent. Soc.*, 1893, p. 139) that, in September, 1893, in a grassy lane between pasture-land which is dry and open, and where, besides many species of grasses, *Lotus*, *Galium*, *Cardamine*, etc., abound, and where, especially, species of *Rumex*, common sorrel (*R. acetosa*), etc., grow in quantity, *R. phlaeas* was abundant, and that, "on September 23rd, the first plant of *R. acetosa* inspected showed about a dozen ova placed anywhere on the leaves, upper- and undersides, and even along the stalks when exposed. Succeeding clumps were equally productive, and, in some cases, individual leaves of a plant were literally besieged with eggs, *e.g.*, a withered leaf on a long stalk projecting on the footpath, was found to have twenty-one eggs and four young larvæ attached to it; altogether, in an hour, more than 100 ova were selected, and at least twice as many left for future observation of the larvæ. This abundance was, in a manner of speaking, quite local. One side of the grassy lane faces the southeast, and catches the early morning sun, there is no ditch, and the sorrel and dock grew quite commonly under a hedge in a dry gravelly soil; here, although dock was equally plentiful with the sorrel, the latter plant was always preferred, indeed, on only one clump of dock were ova and larvæ found, and these on a young and stiff-leaved plant. The luxurious growths of common dock were entirely neglected, as also were both species of *Rumex* when growing amongst the turf, or in a damp ditch running the length of the opposite side of the lane." Bird notes of the egglaying of *R. phlaeas*: "I watched, near Tintern, several females ovipositing on August 30th, 1906. The females of this species do not, so far as I have noticed, alight directly upon the plant they eventually lay on, but settle on some other plant close by, such as a buttercup, or plantain leaf, a grass stem, etc., where they remain for some little while, perhaps, half a minute or so, resting in the sun. Then, if the sorrel plant be quite adjacent (it is generally within a foot or two of their resting-place), they crawl to it, otherwise they will use their wings. After reaching the sorrel they walk all over the surface of the leaves, frequently feeling them with their abdomina, but always laying their ova on the underside. Small plants are invariably chosen (at least, by the second brood), laying even on quite small seedlings. I saw one egg laid on a little seedling that might easily have been covered by a crown piece. One ♀ I watched I thought had made a mistake and oviposited on grass, but I found, when securing the egg, that she was too good a botanist, or rather her instinct was too strong for her

to be deceived by appearance. She had correctly determined the plant as sorrel, notwithstanding the fact that every leaf had been completely eaten off, leaving only the bare stalks, and it was upon one of these she laid her egg, and on the underside! I never saw more than one egg laid on a leaf, and only once two laid on the same plant; the female that did this laid four eggs at one bout, commencing with these two on one plant, and then crawling across a dry cowpad to two other little plants, laying one on each. I kept four ova from different females, three only hatching five days after being laid. Two of the larvæ are still (October 2nd, 1906) alive, and growing very slowly." Newman says that "the egg is laid on the leaves of several species of *Rumex* as *R. obtusifolius*, *R. pulcher*, *R. acetosa*, *R. acetosella* (docks and sorrels)." Merrifield also says that eggs are laid, in confinement, on dock or sorrel. Buckler, that they are laid on leaves of *Rumex acetosella*. [Bromilow notes (*Soc. Ent.*, viii., p. 178) that he observed a ♀ laying her eggs on the dry leaves of *Trifolium filiforme*, near Vence-Cagnes, in the Nice district, on April 4th, 1893; the two bluish-white eggs he found were round, with a flattened base, by which they were attached to the underside of a leaf.] For Scudder's note on the subject, see *anteà*, p. 344, and for the length of the eggstage in the different broods in North America, see *anteà*, pp. 345-346.

Egg-Parasites.—Scudder says that the eggs are attacked by one of the little egg parasites, *Telenomus graptae*, which emerge through one of the lateral cells of the egg.

Ovum.—The egg is 0·61mm. in diameter, and less than 0·3mm. high, just a little less than a hemisphere. If it varies from a hemisphere in form, it is in the direction of having been rather more than a hemisphere, but a little sunk and flattened on top, a little bulging at the top of the sides. At first glance it appears to be pure white, but, on closer examination, this appears to be due to the sculptured surface, a very evident underlying green occupying the hollows. The surface is covered with large (comparatively to size of egg) hollows, of approximately spherical surface, each hollow 100° to 120° of a sphere in diameter. It is not, perhaps, self-evident in *R. phlaeas*, but is so nearly so in the similar egg of *Heodes virgaureae*, that it may be assumed that there is a simple dome-shaped eggshell, and that the sculpturing is in a frothy or corky layer superficial to this. Probably, its whiteness is due to the inclusion of minute air bubbles. These superficial hollows vary a good deal in different eggs; usually they have a spherical surface, but now and then they appear to have a flat bottom, *i.e.*, down on the real egg-surface, and the divisions between them are more walls than portions of a continuous solid layer. The relative sizes of the hollows at different parts of the egg also vary a good deal, especially about the micropylar region. In some, the micropylar region is the bottom of a cell that looks much like the rest of the cells. In others it seems to be a special hollow, surrounded by smaller cells. In all cases, probably, the micropylar area is the surface of the eggshell proper, free from the frothy coating that affords the general sculpture, and this area may have more or less the aspect of one of the hollows of this sculpture. A specimen mounted in "balsam" seems to show this. It happens to be one with very large cells to the general sculpture, 0·15mm. or 0·16mm. in diameter, in one or two of those measured.

The micropylar area is about 0·11mm. in diameter, and is crowded with small reticulate cells, more or less hexagonal and more or less whorled in their arrangement from the centre outwards, so that, from the centre outwards in the curved line of the whorl, one may count five to seven cells, each, therefore, not far from Scudder's measurement of them, *viz.*, 0·01mm. in diameter. Centrally is an area about 0·02mm. in diameter, in which are four or five black or brilliant (according to illumination and focus) points (the actual micropyle ?). Surrounding the micropylar area, or rather bounding it, is a margin of the frothy superstructure, and this being nearly transparent in the "balsam," cells like those of the micropylar area are seen to continue out beneath it, until the coating is too thick to admit of certainty; these cells are only slightly larger than those of the micropylar area. Scudder's figure of the micropyle of this egg (*hypophlaeas*) gives a good idea of the relation of the area to the surrounding pits, but is quite diagrammatic, showing two rows of cells in the micropylar mesh, each separate and distinct, instead of five or more rows pressed together honeycomb fashion. The egg has a central hollow 0·09mm. in diameter, with a central minute, darker point; round the central hollow are eight cells varying in diameter from 0·03mm. to 0·08mm., round this are larger ones 0·09mm. to 0·14mm. in diameter, and the cells are, if anything, larger down to the base. (Scudder describes the egg of *hypophlaeas* as having smaller cells round the base. I suspect eggs of *phlaeas* could be found of this form, and eggs of *hypophlaeas* of the form observed in the specimens I am now examining.) Although the impression is strong that these spherical depressions are circular, this is not so, they intersect each other, and the appearance is as if the frothy material were still plastic after the impressions were made. The lines of intersection are not curves hanging from point to point, but are distinctly angulated at the lowest point, and the triangular projections, where these depressions meet, have tolerably flat sides, meeting in fairly straight lines, and terminate in a point, never in a surface. The margin of each hollow, therefore, where they are fairly regular and hexagonally placed, consists of six angular points and six re-entering angles between them, low and flat, but otherwise like the spikes of a conventional stage crown. The texture (or marking) of the surface within the hollows is dotted and confused, and seems to be best described as the result of what really is, probably the fact, *viz.*, the vesicular structure of the white superficial sculptured coat of the egg (Chapman, October 1st, 1906). Twelve eggs examined, except in size, appear to resemble exactly the egg of *Heodes virgaureae.* They have a diameter of ·55mm. at the base, height ·33mm.; in shape, they represent a rather depressed segment of a sphere, the surface of which is covered with hexagonal, honeycomb-like cells, of pretty considerable size; at the apex, the micropylar cell, surrounded by six smaller cells; the lower rounded basins of the cells are extremely finely reticulated. The ground colour is grey-green; the strongly projecting hexagonal cell-walls are whiter; the base of the egg is light green (Gillmer). Circular in outline, rather flattened, though convex, of a light cream colour, very coarsely reticulated with whitish raised network. Two days before hatching the colour changes to greyish (Buckler). The egg is figured by Clark, *Ent. Rec.*, xii., pl. xi., fig. 1; see also our pl. iii., figs. 3 and 4. For Scudder's description of the egg, see *anteà*, pp. 343-344.

Variation of ovum.—When first laid the ova are faintly greenish, soon turning to a faint green-grey, and then slightly brown, as the time of hatching approaches. The eggshell is opaque and comparatively thick. The ovum hatches in from 5-24 days, depending on the temperature. The ova vary greatly, but fall into two groups, those with small cells, and those with a few larger ones. Those with small cells are the larger ova, those with large cells are the smaller ova. Diameter, ·4mm. to ·5mm.; thickness, five-twelfths of diameter. (1) *Description of larger type of ovum.*—Ovum button-shaped, *i.e.*, like a flat dome, and has the appearance of being honey-combed or sponge-like. The bottoms of cells faintly greenish, and dotted and striated. There are two (generally) series of intersecting lines, which are white and undulating. These give rise to a series of polygons, mostly fairly regular hexagons. These lines as they approach points of intersection ascend and thicken, giving rise to a series of triangular pyramids. Some ova, owing to the variation in size of polygons, do not have two series of lines, but are marked with irregular polygons all over. Base, or attached area, green and faintly cross-hatched. Micropylar area appears darker green to naked eye, and is roughly polygonal and finely punctured. The micropyle is surrounded by an incomplete ring of very small irregular polygonal cells. Next is a fairly complete ring of nine cells, mostly pentagons, one-eighth area of average cell area. Then we have cells produced by the intersecting lines as above. Some of these are heptagonal where they adjoin two of the ring cells. (2) *Description of smaller type of ovum.*—The micropylar area is as above. Following this are only two rings of cells, all hexagons; in the first ring, seven cells, and in the next ring, ten cells. These smaller ova are thicker and more convex than the first form (J. W. Harrison). These two forms of ova are figured respectively in our pl. iii., figs. 3, 4.

Habits of larva.—Scudder says (*Butts. New Engl.*, p. 1005) that "the caterpillar makes its exit by eating only the summit of the egg, where the pits are small, and separated only by thin walls; usually it feeds upon the undersurface of a leaf, and, while very young, eats little holes of about its own size halfway through; afterwards, it ploughs its way through the parenchyma of either surface, making straight or slightly curving grooves as wide as its own body, and several times longer; when still older it devours the leaf at the edge." Harrison says "the emerging larva eats a small circular hole from the apex of the ovum, large enough for escape without, however, devouring the rest of the egg." "At first the larvæ are greenish (September 5th, 1905), changing later to straw-yellow (September 15th), and then to bright green; the larvæ eat small irregular-shaped patches from the underside, and nearly through the sorrel leaves, leaving only the upper epidermis remaining; they cling tightly to the leaves by means of their anal claspers" (Wood); when preparing for a moult the small larvæ appear always to rest on the lower side of a leaf. Buckler says that the young larva is sluggish, and though it occasionally eats holes through the leaves, it more generally makes a little channel on the undersurface just the width of its body, and about its length, so that the larva lies sunk in this channel, about on a level with the surface of the leaf. It then either quits this to make another similar hollow in which to rest, or else it continues to lengthen the channel already made, always keeping to the

undersurface of the leaf, eating the green cuticle there, which is much thicker than that on the uppersurface of the leaf. The third (or fourth) instar appears to be the critical one. In the summer brood, a larva of 6mm. will grow to nearly 16mm. in six days, and feed up to pupating stage in four days longer, whilst in the autumnal brood the larvæ of this size slacken off, and become more or less sluggish, preparing for hybernation. Hawes observes (*Proc. Sth. Lond. Ent. Soc.*, 1893, p. 140) that, in nature, he has never found larvæ feeding on the upperside of the leaf, and that they appear like those of *Hamearis* (*Nemeobius*) *lucina* on *Priumla*, to attach themselves to the underside, *i.e.*, on the side least exposed to the light and their feathered enemies, where each larva eats out small portions and rests in the cavities so made, from time to time wandering to the other parts of the same leaf during the first week or so of its existence. At this early stage it is difficult to detect with anything like certainty, and the best plan is to gather the riddled leaves with the eggs and eggshells, and keep them in a dry situation well surrounded with fresh leaves of the foodplant. Scudder further observes that just before pupation the fungiform appendages of the coming pupa appear as white hemispherical papillæ dotting the surface of the caterpillar. The different rate at which larvæ from the same batch of eggs feed up is very marked in all the broods. Raynor observes (*in litt.*) that, from eggs laid in early June, 1905, the fastest larvæ commenced to pupate on July 20th, that by July 24th there were eight pupæ, and, of the remaining larvæ, some were fullfed, and others yet quite small. Sabine notes (*Ent.*, xxxvii., p. 285) that, of a large number of larvæ reared from August-laid eggs, in 1904, many had pupated by the end of September, and produced imagines in October, whilst, at that time, the greater part of the remainder, consisting of some hundreds, were only half-fed, or little more; so that one supposes most would hybernate, as is usual, as larvæ, and not attempt to feed up and produce imagines the same autumn. Cooper also observes that, from eggs laid August 2nd, 1884, some of the larvæ fed up rapidly on a growing plant of sorrel, pupated, the imagines appearing between September 19th and 22nd; at this time, other larvæ belonging to this batch were nearly fullgrown, and others still quite small; the former would, of course, attempt to complete their life-cycle in the year, the small ones, no doubt, would hybernate. Chapman notes that, "on September 3rd, 1906, a small brood of larvæ, from eggs laid about a fortnight previously, differed to such an extent that one is in the pupal state, two or three are girthed up, six or seven nearly fullgrown, the remainder (two or three dozen) still small, fond of bunching themselves up almost into little balls about 4mm. long, and 2mm. thick; they still eat, and for the moment evidently are not thinking of hybernating (the last few days has been 90° in the shade, or thereabouts). By September 12th these small ones, however, had made no progress, and seem now to eat nothing. They show a few white points (trumpet-hairs) absent in larvæ of *Chrysophanus* var. *rutilus* at hybernating stage." Prideaux states that *Rumex acetosella* is so hardy a plant that, even in severe winters, it probably affords the most suitable resting-place for the over-wintering larvæ of *R. phlaeas* to rest upon, he adds that the larvæ hybernate at different ages and feed in mild weather. The earliest and best placed of the hybernating larvæ feed up very rapidly in the spring. Hodgkinson says they are already

to be found fullfed in April, when one is searching sorrel roots for *Gelechia* larvæ. At Brighton, Johnson found individuals well fed on March 26th, 1893, but this was a phenomenally early year. Newman states that the summer larvæ feed up in about 20 days, and when fullfed rest on the underside of leaves of the foodplant, in a flat position closely appressed to the surface; if disturbed or annoyed, a larva falls from its foodplant, and assumes a crescentic form, the two extremities approximating, but not meeting; after a time it resumes its wonted appearance, and glides over the surface of any object on which it may happen to rest, exactly in the manner of a slug, no separate motion of the body or legs being perceptible. Schneider says that, at Tromsö, the larvæ certainly hybernate at very various ages, and this accounts for the long drawn-out period of flight, but Strand speaks of a certain second brood in the Suldal and various other places in Scandinavia. For the different lengths of larval life in the various broods in North America, see *anteà*, pp. 345-346. Buckler notes that, "when fullfed, and the larva has taken up its position for pupation, it becomes somewhat shorter and thicker, more rounded in outline, the pupal stage being fully assumed after two days."

Variation of larva.—The larvæ when fullgrown present varying forms, but these may all be briefly dealt with. The larva is green, sometimes entirely green, which may vary from pale yellowish-green to dark green, but often with pinkish or purplish dorsal and spiracular stripes; these may vary from faint and narrow lines to full-coloured and wide lines, extending, in some examples, respectively, downwards and upwards, until in the most extreme cases they meet, and the green is lost in the pinkish or purplish suffusion. Hawes says (*Proc. Sth. Lond. Ent. Soc.*, 1893, p. 140) that the larvæ, when large, present varying forms, which may roughly be divided into those that are merely grass-green, and those that have, besides, dorsal and spiracular pink stripes; these latter are very handsome, and appear to produce a large proportion of ♂ imagines, although not exclusively confined to that sex.

Larva.—*First instar* (newly-hatched): Ashy-grey, with black head; a double dorsal crest of dark hairs, half as long again as the larva is thick; larva about 1mm. long, 0·3mm. wide; lateral hairs white, shorter, difficult to see; a very small, square, dark mark for prothoracic plate; some black dots, but no hairs, between dorsal and marginal hairs; dorsal ridges not sharp (April 26th, 1906). *First instar* (fullfed): shows a good deal of colour and marking; about a third of the way from dorsal to lateral flange is a yellowish line, a band consisting of a yellow stripe on each segment, obliquely upwards and backwards, so that that on one segment starts just below the end of the last one; it is bordered above and below by a narrow red shade; there is some reddish shading halfway from this to lateral flange, which has a reddish shade above it; the line of tubercles on dorsal flange has a good deal of reddish; the lateral flange is not coloured, but agrees with the ground colour, which is of almost a flesh tint rather than a green. The little larva is barely 2mm. long when stretched, and the dorsal hairs of i are about 0·6mm. long, and bent to about 60° of a circle; they stand erect, the curve giving a backward sweep, with the effect of a fine crest when the larva is viewed sideways; they are finely spiculated; those of opposite sides

arise so close together, that, whilst hardly appearing to have their bases conjoined, it is difficult to be sure they have not, especially on the forward segments. Tubercle ii carries a short hair 0·1mm. long, deflexed, arising close to, and outside, i. Halfway between this and the spiracle, in middle of segment, is a large lenticle (a little larger than spiracle). Slightly above this, and at the posterior border of the segment, is a very minute hair, and a similar one about halfway between the lenticle and spiracle; this varies in position, usually rather nearer spiracle; on one side of one segment it is close under the lenticle; again, there is a similar minute hair behind, and a little below, spiracle. In two specimens (British), on the 4th, 5th, and 6th abdominal segments, in front, and outside i, where an accessory hair is common in Lycænid larvæ, is a small hair of peculiar structure; it is not more that about 0·01mm. long, and is fan-shaped, with several points at the end. In two Riviera specimens these are absent, except that, on one side, in one specimen, on the 6th abdominal segment, is a similar hair, but a little more baton-like in shape. Below the spiracle (on flange) are three hairs on a level, the middle one a little the longest, 0·2mm.; on the 3rd, 4th, and 6th abdominal segments there is a fourth smaller hair in front of these; lower is a very large lenticle, then a small hair (0·02mm.), and then two at the base of the prolegs. On the 7th abdominal, i is present, with four lenticles behind it. On the 8th abdominal, i is present, with two lenticles behind it. On the 9th abdominal, i is present, and the two hairs are some little way apart, and there are no lenticles. The lenticle between i and the spiracle is absent on the 7th, 8th, and 9th abdominal segments. The 10th abdominal has an anal plate, with two lenticles on each side, and with five hairs beside and behind it, on a surface with long sharp skin-points; the 8th (with 9th) abdominal segment shows four marginal hairs. The submarginal lenticles, which are very large (twice the diameter of the spiracle), are present only on the 3rd, 4th, 5th, and 6th abdominal segments, but on the 1st and 2nd its place is taken by a long hair. On the metathorax the spiracle and the lenticle above it are absent; there are four equal marginal hairs; in line of submarginal lenticle are two small hairs, with a small lenticle behind them. On the mesothorax, tubercle ii carries a hair exactly like i (at least there is such a hair, that it truly represents ii is another matter); there are four marginal hairs, and a lenticle in front of them, two hairs and a lenticle below, as in metathorax; no hairs at the leg-bases. On the prothorax are seven marginal (?) hairs on either side, which run round below plate, but above spiracle; below the spiracle there is one hair. The plate is square, with three long hairs at each anterior angle, minute ones behind, of these the largest (very small) are near the posterior angles. The general surface is faintly reticulated with a largish mesh. The front of the prothorax is nodulated with rounded skin-points, much closer together than the meshes of the skin-netting behind. The prolegs have thirteen to fifteen hooks, more than usually in a complete line (not divided into two pads) (May 5th, 1906). *Second instar* (newly-moulted): The colours are more blurred and the white-yellow band looks straight; there are two sets of hairs on the slope between the dorsal and lateral flanges, but the slope is a little rounded both in this and the first instar (fullfed). [The typical Lycænid slope is not at all marked, except in quite young larvæ in the

first instar, and then nothing to approach say—the larvæ of *Ruralis betulae*.] *Same instar* (well-fed): The larva at rest is 3mm. long, 1·5mm. wide, an extremely short, round item, nearly as high as wide. In one case the larva is green, with perhaps darker dorsal, and pale lateral, line, and even, perhaps, some intermediate lines; in another, the dark dorsal line is faintly pink; in a third, there is a strong pink tone both dorsally and laterally. There is still quite a definite "slope" from the dorsal to the lateral ridges. Looking at the larva end-wise, there is the double dorsal row of black hairs, with shorter ones along with them, and some very short ones dorsal to them; then there are the lateral flange hairs, curved downwards in an upper and lower row, and the "slope" is divided into three, about equal, portions, by two rows of hairs, the upper curved upwards, and about half as long as the long dorsal, the lower nearly as long and curved downwards; some shorter intermediate ones are not satisfactorily determined. The hairs are more numerous and about 0·2mm. to 0·3mm. (a few 0·4mm.) long. The prothorax has, over the dorsum, about thirty hairs on each side, not specially arranged or grouped. The spiracle is right back in the incision, looking as if in mesothorax; it is accompanied by two lenticles and a hair; there is a group of smaller hairs down in front, with, across the front, a number of pale circles, that may be lenticles, the inner two seem to have colourless hairs. Doubtful as to whether belonging to pro- or mesothorax are two median lenticles, a fine hair, near the middle, on either side. On the meso- and metathorax, on spiracular level, are two hairs, accompanied by a lenticle that looks exactly like a spiracle, being on the same horizon; each of the abdominal spiracles is accompanied by two lenticles, looking very like it; on abdominal segments 6 and 7 there is an extra (making three) lenticle and a hair; these are all above and behind the spiracle; on abdominal segment 8, a hair and two lenticles; a little above this, and to the front of the segment, on the mesothorax and abdominal segments, is a hair, another at the posterior border of the mesothorax. Dorsally, taking two large central hairs to represent tubercle i, we have ii just behind and outside it, a median small hair between, a hair (small) in front of i, and another further out and further forward, close to the front border of the segment, a longish hair lower (iii?), then the front border one, and the one against spiracle; the marginal group numbers about eight; the seta on i is about 0·4mm. in length, those on ii and iii are nearly as long, and so are some of the marginals. On the anal plate are eight or ten hairs and four lenticles. The hairs are difficult to distinguish from a score or more round posterior margin. The prolegs carry four hooks (in three sizes) on each pad. The skin-surface is divided by a pavement-network, each cell of which carries a minute central spicule. *Third instar* (laid up for moult): 7·5mm. long, 2mm. wide, 2mm. high, at the 2nd abdominal segment, which is the highest point. The colour green, with red dorsal and lateral lines, and variations as in last skin. The width is also greatest at the 2nd abdominal segment; it narrows slightly to the 6th, more to the 8th, whilst the 9th and 10th abdominals give a rounded end, just as the prothorax does in front. There are no definite dorsal ridges, but, from the narrow rounded top, two "slopes" fall to lateral flange; they are quite marked, but are a little full and rounded, not flat. Some of the dorsal hairs are still a little longer than those on slopes, but, except

that there is a barer place between the spiracles and lateral flange, the hairs are tolerably equally distributed; those above the spiracle black, those below pale; brilliant white points are irregularly scattered on surface. The larva differs from its appearance in the fourth and last instars by the hairs being a little differentiated between top and sides, and in having few white points. In the third instar the hairs are shorter than in second instar, 0·3mm. down to 0·1mm., and are more numerous. The lenticles also are much smaller proportionally, those about spiracles less than half the diameter of spiracle, instead of being very like them. There is some space free from hairs just below the spiracles, but, for the rest, the hairs are everywhere distributed, but are still in groups; the dorsal patch contains about twelve hairs on either side, of which two larger ones may represent i and ii, but others are of nearly same size; the area possesses two or three lenticles (asymmetrically placed). The "slope" down to spiracle has about eighteen hairs; its larger area makes it look less crowded than the dorsum; the hairs also are smaller. This area has seven or eight lenticles, of which the circumspiracular three or four form part. After an interval comes the marginal group, about twenty-two hairs and three lenticles; a group of eleven pale small hairs and a lenticle are at about the site of tubercle vi, and a less group of smaller hairs at vii. The hairs round front and back margin are very numerous. The prothoracic plate is small, tinted, with two hairs posteriorly (a pair), and one or two minute ones, and several lenticles. The prolegs have the two pads (usual in Lycænids), of which each has six or seven hooks, very large, long, and powerful; on the inner side of the prolegs is a separate line of six or seven very small hooks. The skin-surface has a more or less hexagonal epithelium. The white points (the forerunners of the trumpet-hairs of pupa) are very beautiful objects when magnified, they are white, with long curved branches. Suppose a fir-cone (one with more numerous scales than *Pinus sylvestris*) had a long white spine branching from each scale and curving upwards, all the spines arranged in proper tactical order, it would be something like it. On an end view, the white cone hairs have a slightly whorled appearance, and the ends of the branches seem dilated; most views give the impression that the branches, or spicules, are not free and separate, as they usually look, but are held in place by some envelope or connecting medium. They are more numerous in the last instar. *Fourth instar:* In the fourth instar, the hairs are a little more numerous, and are longer than in the third; the longest about 0·5mm. The distribution is much the same, but it is difficult to draw a line between a dorsal group and one belonging to the slope, and the bare space below spiracle is actually narrower than in the third instar. There may be forty-five hairs from dorsum to spiracle, twenty-six or so in marginal group, thirteen or fourteen at position of tubercle vi. The lenticles are proportionally much smaller and very numerous, fourteen from dorsum to spiracle. The prothoracic plate is long, pointed at each end, and with two pointed branches on each side, making it look something like an animal's skin nailed out to dry; it carries four or five hairs on either side. The skin between the head and prothorax, or, at least, the margin in front of the marginal fringe of hairs, has very numerous, and very short, colourless hairs (not skin-points); the prolegs have seven or eight hooks, and also about eight very minute ones

in a row, right down on the inner margin. *Fifth instar:* The last skin is plentifully studded, not only with black hairs, but with brilliant white points, of which there are over fifty, above lateral flange, on one side of an abdominal segment; they are nearly as numerous below. The hairs are very numerous, more than a hundred on one side above spiracle; they cannot be recognised as in a group, but are fairly equally distributed. The marginal set are, however, thicker and longer, and those of vi and vii are still grouped; lenticles are abundant. The pads of prolegs carry fourteen to sixteen hooks, and there are five to eight in the inner marginal set of small ones; those on the pads are in two or three sizes; on the claspers the two pads have about sixteen and twenty-five hooks. There is no trace of subsegmentation, nor of oblique lateral stripes, as seemed to be promised in the first and second instars. There is not only nothing that would attract attention as a double dorsal flange, but it is difficult to persuade oneself that it still exists even theoretically. The upper surface of the larva is rounded from one lateral flange to the opposite, and is much higher than in the larva of *Chrysophanus* var. *rutilus*, and, consequently, much less suggests a slug-like form. The general skin-surface has a very fine tessellated reticulation, without anything like skin-points. Skin-points, however, exist on the fine membrane forming the neck; they are extremely fine and close together, and almost colourless. This neck is about as long as the head, just enough to enable the head to be invaginated within the prothorax, with a little assistance from the incurving of the skin margin. Except, perhaps, in the first part of its first instar, the larva cannot be said to burrow at all, as those of many Lycænids do, so that this structure can here be of no use for that purpose, it is not much longer than in many other (non-Lycænid) larvæ. The true legs are pale ochreous. The widths of the head at the several instars are, approximately, first 0·24mm., second 0·40mm., third 0·60mm., fourth 0·90mm., fifth 1·35mm., giving a ratio of enlargement at each moult of two to three, a trifle more at the first moult (Chapman. May 14th, 1906). The fullfed larva is 15·7mm. in length, thick in proportion, somewhat onisciform, but without any dorsal ridges or hollows; the back curved, sloping on the sides, and at each end, where it tapers a little. The prothorax is rather longer than the others, bilobed at its front margin, the sides dilated a little below the spiracular region; the segments very well defined by close and moderately deep divisions; the belly flat, or rather hollow; the head very small, and hidden beneath the projecting lobes of the prothorax, as are all the legs beneath the body. The head is pale brown in colour, with a darker brown spot at the base of the papillæ, and just above the mouth a thin streak of darker brown runs across; the skin of the body is green and velvety, irrorated with minute flesh-coloured dots, each emitting a light brown, shortish, fine bristle; there is a faint appearance of a brownish dorsal line, the spiracles are flesh-coloured and tolerably distinct; on the prothorax is a fine flesh-coloured dorsal line, rather sunk between the lobes; all the legs and prolegs pinkish flesh-colour (Buckler). *Quiescent stage preceding pupation:* The coloration still marked—dorsal area red, subdorsal bright green, with pinkish lavender where they blend; these are olive-green when seen laterally, rather pink when seen dorsally down to spiracles, beneath the latter pink, especially bright along flange; the pink below front segments tends to be more olive (Chapman. May 16th, 1906. Pupated May 18th). Newman

also describes the fullfed larva (*Ent.*, ii., p. 122). For Scudder's description of the various larval instars see *anteà*, p. 344.

Pupation.—A larva, laid up for pupation, May 16th, 1906, has made quite a cocoon by fastening adjoining leaves, etc., with white silk, apart from the pad on which it rests. There appears to be very frequently a "cocoon" to the extent of a few threads, attaching any object lying laterally or dorsally. The larva is suspended by the terminal cremaster and by a girth, consisting of a number of strands more or less separate. The girth passes rather forward to its attachments, *i.e.*, if it were exactly transverse from its attachments it would cross over the metathorax. On May 18th, pupation took place. The girth then fell across the 2nd abdominal segment. It usually falls so far forward as to be perhaps more properly described as being in the incision between the 1st and 2nd, but it may even cross the outer posterior angle of the 1st, abdominal segment. On the other hand, it may be as far back as just in front of the spiracle of the 2nd abdominal segment. There is no provision (as for instance in *Papilio machaon*) that the girth shall take an uniform position, still less that it shall be fixed there. The larva that pupated on May 18th, remained, when a pupa, of the same colours as the larva—red, green, with some yellow, and studded all over with brilliant white points; these seem to be the same as the white points of the larva, but, on examination with lens, are seen to be the umbrella- or trumpet-hairs. By the 20th, however, the pupa had lost all its brilliance; it is now of a deep reddish-brown, compounded of a terra-cotta ground colour and much deep brown spotting, concentrated dorsally and laterally into bands, also denser, round the margins of the thoracic segments, and between veins of wings. Under a lens, the black dots and netting of the surface give very strongly a false impression of a clothing of black hairs. The trumpet-hairs, instead of being conspicuous and brilliant as when first moulted, now require considerable magnification and some search to discover. The larval skin is still entangled amongst the silk near the cremaster; the girth is between the 1st and 2nd abdominal segments, passing rather backwards from its attachment; spiracles whitish-yellow, the cover of the prothoracic one very conspicuous (Chapman). Buckler says that the fullfed larva spins a silken web to which it attaches itself, also a triple thread round the body behind the thorax, and thus pupates. Newman observes that it attaches itself to the underside of a leaf or to a petiole, and there pupates, the extremity of the pupa uncurved and furnished with extremely minute hooks, by which it is attached to the web previously spun by the larva; it is also fastened by a surcingle round the waist (*Ent.*, ii., p. 122). For pupation it fastens itself to a stem by means of some silken threads (Rössler); the pupa is fixed by a girth to strong stems of plants (Pabst); the chrysalis is found hanging upon the undersurface of stones (Scudder).

Foodplants.—*Rumex acetosa* (Schiffermüller), *Rumex acetosella* (Paul and Plötz). Where dock and sorrel are equally plentiful, sorrel is always preferred, and only on some young stiff-leaved plants of dock were ova and larvæ found (Hawes, *Proc. Sth. Lond. Ent. Soc.*, 1893, p. 39). Newman suggests (*Ent.*, ii., p. 122) *Rumex obtusifolius*, and *R. pulcher*. Fiddledock, ? *R. pulcher* (Bate, *Ent. Rec.*, vii., p. 302). *Rumex crispus*, *R. scutatus* (Stefanelli). Hawes and Merrifield give "dock," without specifying the species, etc. Moncreaff notes (*Ent.*, iii., p. 41) that, on

December 17th, 1865, he found a number of caterpillars of *phlaeas* feeding on dock and "ragwort." [One suspects "ragwort" to be a mistake. Boie records *Poa annua*, an evident error.]

Parasites.—*Ichneumon versabilis* attacks the larva, and emerges from the pupa; one emerged fifteen days after pupation (Scudder).

Pupa.—11mm. long, 6·25mm. wide in the thickest part of the abdomen; very thick and dumpy in appearance, the depression between the thorax and abdomen slight; wing-cases rather long, but not projecting; the abdomen turned down near the blunt tip; the parts around the head rounded. Of usual Lycænid type; pale brown in colour, with reddish tinge, freckled with darker brown, distinct reddish to black-brown mediodorsal line. Neuration outlined on wings pale. Thorax broadly margined with blackish; the abdomen with three rows of black dots on each side, those of middle row the largest; spiracles oval and flesh-coloured; surface of wings and legs smooth, other parts covered with short trumpet-hairs. *Dorsal view:* The prothorax large and prominent, forming the anterior edge. The first spiracle some distance from antenna, with a pale, prominent lip; a slightly raised mediodorsal ridge on thorax; the metathorax narrow medially, wide laterally. The 1st thoracic segment slightly depressed; the 2nd, 3rd, 4th, 5th, and 6th abdominal segments well developed and moderately straight, the remainder curved gradually backward (ventrally). Each abdominal segment slightly depressed in anterior part. A row of supraspiracular black dots on either side, one above each spiracle. *Lateral view*: The antenna comes up and crosses the front part of the head and ends on the frons. The glazed eye, ventral to antenna. The 1st spiracle, prominent, in line of separation of meso- and prothorax, some distance from antenna. Base of wing slightly raised; with the inner and outer marginal edges smooth. The wing dark brownish with pale neuration marks, the latter not reaching outer margin of wing; the hindwing scarcely traceable, but just evident at base and anal angle. The spiracles on the 2nd to 7th abdominal segments conspicuous, that on 1st abdominal segment under the wing, on the 8th abdominal segment aborted. A row of small, black, supraspiracular dots. Cremaster blunt with red hooks. *Ventral view:* Head rounded, bounded anteriorly and laterally by the antennæ, the bases of which unite in the middle of the frontal line. The maxillæ comparatively short, ending about two-thirds down the length of the wing. The first pair of legs wide at top, covering base of second pair, and ending at about two-thirds down maxillæ; the second pair reaching nearly to end of maxillæ. The antennæ, separated by width of pupa at head, are in contact below maxillæ, and extend beyond tips of wings; antennæ faintly segmented; surface of legs and maxillæ mottled. Raised transverse ridge extends from the antenna on one side to antenna on other, and forms boundary of maxillæ and first pair of legs. Glazed eye lunular, depressed, black, with brownish raised margin, extends from base of first pair of legs to antennæ. Wing very slightly protuberant just above base, transversely depressed in centre owing to cincture; streaked longitudinally with pale and dark brown, the paler lines showing neuration. The antennæ pressed into the 5th abdominal segment, the remaining abdominal segments much contracted. The cremaster rounded, blunt, made up of two ill-developed lateral ridges, sparingly covered along the

line of the ridges and the end with red hooks. The 9th abdominal segment with two raised points, one on each side of a median longitudinal fissure. Surface of abdominal segments bearing short trumpet-hairs (Tutt, June 13th, 1893). The pupa is 11mm. long, thick and rounded, 2mm. from front, it is 3mm. high at mesothorax, and 4mm. at 3rd abdominal segment after a slight waist; it is still 3mm. high, 2mm. from the posterior end, *i.e.*, at the 6th abdominal segment. In occasional specimens the wings encroach on, and are attached to, the 5th abdominal segment. Generally they do not pass the usual position on the 4th. The widths are almost identical with the heights, but the venter, being fairly straight, the dorsal curves are about double the depths (or curvatures) of the lateral ones. The trumpet-hairs are easily made out (with a lens), but are inconspicuous, except when the pupa becomes very dark before emergence, when they stand out brilliantly as white points. The spiracles are pale, but not conspicuous; the cover of the prothoracic one is a bright little yellow line. The projection of metathorax representing the hindwing ends just before the spiracle of the 2nd abdominal segment. The last six abdominal segments ventrally measure altogether only about 1mm., so much are they narrowed; a further 1mm. of the ventral aspect of the pupa consists of the dorsal surfaces of the 9th and 10th segments; so that, though, ventrally, the pupa extends 2mm. beyond the ends of the wings and antennæ, only half of this is the true ventral surface. The pupa seems entirely incapable of any movement, yet, on dehiscence, there is usually some opening dorsally of the 5th to 6th abdominal incision, and sometimes of those immediately before and behind it, 4th-5th and 6th-7th. In mounting a specimen other incisions may open a little without actual fracture. The cremastral region is a flat round area, about 1·4mm. in diameter, consisting of the 9th and 10th abdominal segments. The suture between the 9th and 10th segments is lost, except for a small mediodorsal portion. Across the middle of the 10th segment is a transverse ridge or suture, hardly raised at all, with a mediodorsal branch. This ridge, which represents, no doubt, the transverse end of the cremastral spine (as seen in *Pieris* and *Vanessa*) is just over 1mm. in length, and carries on either side about 36 brown hooks (probably brighter in colour in the living pupa). They are about 0·05mm. long, proportionally very thick, slightly curved, and end in anchor-shaped or double hooks. Some traces of the suture between the 9th and 10th abdominals may be seen or imagined ventrally; on the ventral aspect of the 9th abdominal, is a central eminence, not very clearly double, with (in different specimens) from one to ten similar hooks on either side, outside and beyond, not on, the eminence. There is, indeed, much variation in the distribution of the hooks. In one specimen, the hooks of the 10th abdominal segment are dorsal to the terminal suture, and this series is continuous laterally with the first series, forming a circle, most dense laterally, round the anal scar, broken only in front by the eminence of the 9th abdominal segment. In a specimen with the anal scar well marked, it is a smooth area with a small point on either side and radiating lines especially dorsal and ventral to it. The 8th abdominal segment in front is distinct in ♂ specimens, obscure in its demarcations from the 9th abdominal in ♀s. The eminence on the 9th abdominal is finely spiculated, as are also, but less markedly, the margins of several hind segments, the general surface being

homogeneous. The extension of the cremastral hooks, not merely laterally along the 10th abdominal, but on the 9th abdominal, beside the genital eminences, is strongly reminiscent of the double cremaster of Alucitids (Pterophorids). The pupal skin has an elaborate sculpturing of remarkable interest. That on the dorsum shows a number of points connected together by fine ridges. These points are of two kinds, very distinct in their nature and structure, and yet, perhaps, identical, in that certain intermediates exist. Those that are most definitely "points" are very much smaller than those of *Thestor ballus*, perhaps one-eighth or one-seventh of them in diameter; of some, the structure is not very evident, but, of most of them, it seems to be very parallel to that of *Thestor ballus*, *viz.*, a raised thick ring, with a central object that is hardly part of the ring, but set within it. The ring is very smooth in outline, both inside and out, and the inner little knob is separated from it by a paler ring, that looks very similar to the membrane or articulation of a hair. The little knob seems of simple structure, and without any of the stellate form of that in *Thestor ballus*. The other kind of "points" consist of veritable hairs, *i.e.*, they have definite circular bases, just like those of ordinary hairs, and, centrally is articulated a movable structure that can only be morphologically a hair. These hairs are, however, of very elaborate structure; they are hollow, and expand at the tops so as to be trumpet-shaped, the bell of the trumpet being large, wide, and expanded, or they may be likened in form to the well-known fungus, the chantarelle. The margins of the bell, however, are not smooth, but cut up into quite a *chevaux-de-frise* of spikelets, and, in some specimens, an inner circlet of similar needle-points can be made out a little way within the bell. One or two specimens suggested that these inner spikes were on a separate membrane, which, when the specimens were fresh, formed a dome-shaped cover to the open mouth of the trumpet. One can hardly help theorising that the first class of points are really hairs like the second, in an abortive or undeveloped state, and, on comparing, critically, these structures, with those of *Thestor ballus*, the stars on that pupa would seem to be similar, morphologically, to the hairs of *Rumicia phlaeas*, but reduced like those of the first kind of points on *R. phlaeas*, to a mere base, but still preserving in their stellate form, the fringed and spiculate idea involved in the trumpet of *R. phlaeas* (see plate x., figs. 1 and 2) (Chapman). Newman describes the pupa (*Ent.*, ii., p. 121). Scudder gives a good detailed description also (see *anteà*, pp. 344-345).

Variation of pupa.—The colour of the pupa varies a little. In all cases a certain green basis exists, but it is, more or less often, one would say at first glance, completely, overlaid by a brownish shade, giving a more or less olive result. This, again, is modified by dark, almost black, markings, which vary a great deal in extent, often fairly distributed, usually more pronounced on anterior half of pupa (including the 1st abdominal segment), and sometimes making the thorax nearly black. The markings may be described as marblings, but massed a little into a dorsal line, and more abundant across the front of the thorax, and halfway between dorsum and spiracles. On the abdominal segments may be especially noted two black spots, which are usually very distinct; one halfway between dorsum and spiracle, the second lower, and posterior to the first; these occur on many Lycænid pupæ;

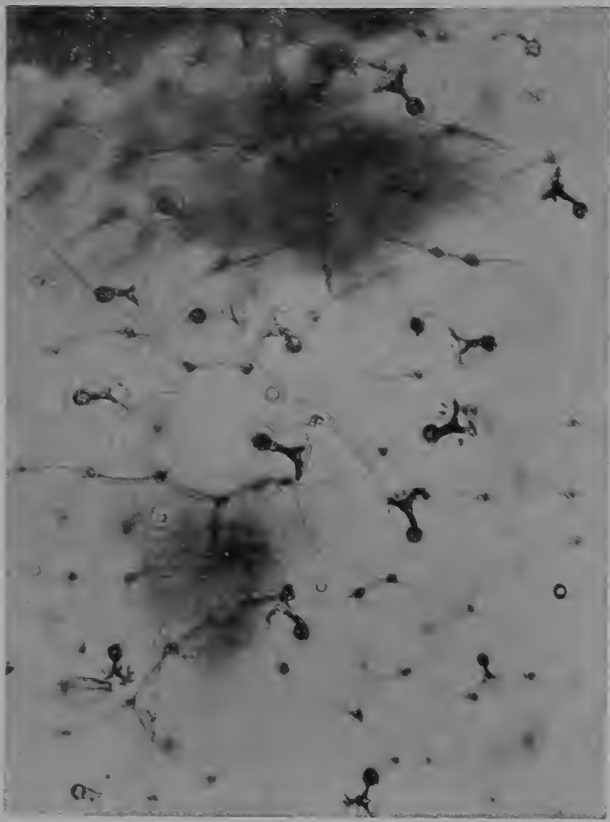

*Photo. F. N. Clark.*

FIG. 1.—PUPAL SKIN OF RUMICIA PHLÆAS × 120.

FIG. 2.—TRUMPET-HAIRS OF RUMICIA PHLÆAS × 200.

they are very distinct, usually, on that of *Lampides boetica*. Amongst a few pupæ the following variation may be noted:

1. Fairly typical, these two black spots distinct.
2. Markings less pronounced; two spots can be made out, as also another (more dorsal) which occurs in many Lycænid pupæ.
3. Pale; spots evanescent.
4. Dark; spots obscured by excess of black markings.

Comparison of pupæ and pupal dehiscence of Rumicia phlæas and Chrysophanus dispar.—Two empty pupa-skins of *R. phlaeas*, received July 1st, 1906, from Mr. Tonge, are both attached to a piece of card, apparently quite naturally. They are much flattened on both abdominal and thoracic areas, thus presenting a marked contrast with the boldly upstanding appearance of the pupa of *Chrysophanus dispar*, as regards its abdomen. They also show a dead surface to the naked eye, as opposed to the dull, but smooth, polished appearance of that of *C. dispar*. This deadness is partly caused by irregularities of surface, but is largely due to the growth of trumpet-shaped hairs scattered over the surface generally, instead of being restricted to the areas surrounding the spiracles, and to the strength of the surface-sculpturing, which is much bolder than in the pupa of *C. dispar*. It is also, to a certain extent, due to coloration, the skin being of a pale, dull, umber-brown, with darker mottling of greater or less intensity, and with a series of black spots. This series consists of a mediodorsal row, of one to each segment, replacing the mediodorsal band of *C. dispar*, from the 1st to the 6th abdominal segments, and a pair set side to side on the 7th abdominal. The splitting at dehiscence spoils the view of the thorax, but this, I think, has a narrow, dark, mediodorsal line in place of the spots. There is a series of two obliquely-set spots above the spiracle, as in *C. dispar*, but they are black instead of white, and their centres are depressed; another series of single spots occurs between these and the mediodorsal series, but there are no oblique stripes. There is also a series of subspiracular spots, which again are black instead of white, as in *C. dispar*. Traces of three rows of ventral spots are also present. The spiracles are conspicuous, large, raised, and slit-shaped. They appear somewhat more raised than in *C. dispar*, but this is possibly due to the rising of the depressed area since the dehiscence, as those of *C. dispar* also seem more elevated since the emergence of the imago. The mode of attachment of the pupa of *R. phlaeas* is the same as in the larger species, but, of course, no curled leaf is present. The girth is, however, stronger, and, in both the pupæ of *R. phlaeas*, is caught in the incision between the 1st and 2nd abdominal segments, instead of lying on the surface of the segment; additional threads are present across the thorax, but none below the band, neither do I see any trace of the laterally attached returning threads, mentioned in the account of *C. dispar* (see *posteà*). The pupal dehiscence, as in *C. dispar*, is by way of a rupture down the mediodorsal line of the thorax, and between the metathorax and the 1st abdominal segment, as well as, ventrally, between the prothorax, head, and antennæ, and also between the pro- and mesothoracic segments, so that the prothoracic piece is separated into two, and either completely detached, or left hanging by the internal membranes. There is, however, one marked difference between the pupæ of this species and *C. dispar*, on dehiscence, in that the antenna-cases do not separate from the head-

piece in *C. dispar*. The coloration of the ventral area of *R. phlaeas* is rather darker than the dorsal, especially the antenna- and haustellum-covers. The wing-cases show darker mottling between the veins (Bacot).

TIME OF APPEARANCE.—The species is single-brooded, double-brooded, triple-brooded, or continuously-brooded, according to its habitat, as determined by its altitude, or latitude, or both. It may, therefore, be seen on the wing at some part or other within the limits of its distribution, from the commencement of January to the end of December. Walker notes, at Gibraltar (*Ent. Mo. Mag.*, xxiv., p. 175), the occurrence of a specimen on January 1st. 1888. There is no doubt that, in the most extreme northerly points of its distribution, it is single-brooded, with a long hybernating period as larva; in the greater part of its habitats in the north temperate regions, both of the Palæarctic and Nearctic areas, it is double-brooded, the first brood of imagines (from hybernating larvæ) appearing from April to early June, the second in late July and early August, with a strong tendency to form a partial third brood emerging in October, which is converted into a very complete third brood in summers and autumns with suitable meteorological conditions. In the south of its range, in the Mediterranean area, this triple-broodedness is complete, whilst the imagines of October often attempt a further brood, which is responsible for the records of imagines occurring in December, January, or February, which one occasionally meets with in the sheltered southern parts of Europe, North Africa, and southwestern Asia. In the Nearctic area the times of appearance are almost the same as in the Palæarctic, but Scudder appears to take no account of its extreme northern outposts nor its habitats at high altitudes, nor, indeed, to give much detail concerning its habits in its most southern localities in North America; still, his account (already given *anteà*, pp. 345-346) of the variation in its times of appearance at various latitudes in America, gives sufficient material for useful comparison with our own data. As bearing directly on this question of various-broodedness is the question of its ability to hybernate in the larval stage in various stadia rather than in one fixed stadium, and also the habit of the winter larvæ, nibbling as it were, even in temperate regions, whenever the weather is at all mild, in order to enable them to get as much growth as possible before their more rapid development in spring. Schneider insists that the species occurs at Tromsö, from mid-June to mid-September, in one long drawn-out brood—giving as specific dates of capture—June 26th, 1877, June 21st, 1883, June 30th, 1884, June 28th, 1886, June 21st, 1890, July 7th, 1891, July 29th, 1897—whilst Strand records that the species is doublebrooded in the Suldal, one brood appearing in June, the other in August, and both these Scandinavian records are possibly accurate, when one compares the different climatic conditions of 69½°N. lat. and 59°N. lat., whilst Schneider's record is somewhat substantiated by Chapman's, who found the species not uncommon between July 10th-17th, 1898, at Bossekop, in 70°N. lat. In support of its continuous-broodedness in the south, Walker's dates for Gibraltar and the surrounding country are interesting. These are (*in litt.*)—January 1st, 1888, on the rock at Gibraltar; February 28th, 1888, in the Cork Woods; February 28th (one), March 7th, April 8th, 1887, in the Cork Woods; June 4th-June 28th, 1887, in the Cork Woods (var. *eleus*); June 9th, 1888, in the Cork Woods (var. *eleus*); August 20th, 1887, near Algeçiras (var.

*eleus*, worn); September 1st, 1874, on the Rock; November 20th, 1886, at Gibraltar; December 3rd-24th, 1887, near San Roque. His further dates from various Mediterranean localities are—At Malta, June 29th, 1874, observed, July 4th, 1874, swarms (darker than in Britain), July 16th, 1874 (strange dark form); Mahon in Minorca, August 19th, 1874, observed; at Gibraltar, September 1st, 1874; at Tangier, September 10th, 1874; at Palermo, October 30th, 1874; at Taormina, Sicily, November 4th, 1874; at Malta, February 21st, 1875, normal (not the dark summer form); at Leghorn, September 14th, 1875; Vesuvius, lower slope, October 2nd, 1875; Malta, October 14th, 1875, and April 5th, 1876, observed; September 10th, 1876, common, very dark and suffused; Port Baklar, April 14th, 1878, first brood, June 11th, 1878, second brood, very dark and suffused, like the Malta summer specimens; Malta, July 3rd, 1893 (var. *eleus*). We have only one date for Abyssinia, *viz.*, January 3rd, 1902, at Fiarrer (Brit. Mus. Coll.). In northwest India, Beluchistan and the surrounding countries, the species also appears to occur all the year round, *e.g.*, it is recorded from Kandahar from October to January, very common (Swinhoe); April and May, common, also in June, abundant (Roberts), at Quetta, in September (Swinhoe). One suspects that, on the Baralacha Pass, at 16060ft., where it was taken in July, 1879 (Nicéville), the species is single-brooded. In the Western Himalayas, at Mussoorie, and, in the interior, from 5000ft.-8000ft. elevation, the species is certainly on the wing from March to September (McKinnon and Nicéville). In Thibet, the species was taken at Gyangtse, 13000ft. elevation, in June, 1904, and at Lhasa, September 21st, 1904 (Walton). In the Himalayas, at Thundiani, on August 24th, 1886, and September 24th, 1885; at Dalhousie, September 9th, 1891; August 7th, 1882, at 10000ft., at Huttos, also October 29th, 1883, at Mandi, at 4000ft. (British Museum collection). In Mooltan there is a succession of broods throughout the summer, the specimens from the Punjaub all being decidedly larger than those from Upper Burmah and the Shan States, where it is also very common (Manders). In the eastern parts of Asia it appears to occur very much as in Europe, *e.g.*, Fletcher reports it as being abundant at Wei-Hai-Wei from April to October, the species apparently triple-brooded, whilst Pryer says that it occurs in Japan, at Yokohama, from March to November, whilst the capture of the species, July 16th-28th, in Kamschatka, by Herz, suggests nothing as to its time of appearance throughout the year. In the Pamirs it is reputed to be double-brooded, one brood occurring in mid-May, the other in mid-July; it is possibly only single-brooded on the Col Beïk, where Grum-Grshimailo captured it at 14000ft. elevation in mid-July; a specimen in the British Museum collection is dated "July 20th, 1887 (Grum-Grshimailo)." In Turkestan, Fedchenko took it on April 19th, 1874, near Samarkand. In Asia Minor it is recorded from March to May—in Cilicia, as a first, and later as a second, generation (Holtz), but there appears to be little doubt from incidental records that, throughout the Levant, the species is to be found pretty regularly from March to November, with occasional individuals between November and February. In Italy it is recorded from February to November, and in the French Riviera the earliest spring examples appear in February and continue until well into November; the very early and very late examples are distinctly, however, only "forwards" of the first (spring larvæ) and

"fourth" (or winter larvæ) broods respectively. Bromilow notes a larva pupating at Nice, October 2nd, 1892, which gave an imago on October 30th. In Germany the insect appears much as in Britain, although, of course, considerable difference occurs according to latitude and altitude, the general suggestion being the occurrence of two or three broods in a year, thus we read—in Mecklenburg, from May to October, probably in three generations (Stange); near Crefeld, from May till October in two or three generations (Rothke), in Wiesbaden, three generations, May, July, and September (Rössler); near Frankfort-on-Main, from April to October, probably in three broods (Koch), near Cassel, in several generations, throughont the whole summer, in early seasons appearing already in April (Borgmann); near Berlin, from April to November, in several generations (Bartel and Herz); flies from May to October, in two or three generations, near Chemnitz, in the kingdom of Saxony (Pabst); near Regensburg, in May, August, and October (Schmid). Other lepidopterists suggest only two broods, each continuing for some time, *e.g.*, near Hamburg, where the insect flies in May and again from July to October (Laplace); near Bremen from spring till autumn especially frequent in late autumn (Rehberg); the first brood commences to appear at the end of April (as early as April 18th, 1854), the second at the commencement or middle of July, at Waldeck (Speyer); near Zeitz, in April-May and July-September (Wilde); in Brandenburg, in May-June and again July-September (Pfützner); near Frankfort-on-Oder, in May and again in July-August (Herrmann); near Brieg, in Silesia, in April-May and again in August-September (Döring); in Baden, in April-May and July-October (Meess and Spuler); aronnd Munich from end of April till end of September (Kranz); in Hesse, from May until October (Glaser); near Schwerin, May 13th-June 11th, 1904, again July 20th-August 10th, when the second brood was over (Gillmer). Further interesting notes from the south are as follows: In the Alpes-Maritimes, it flies almost the whole year and everywhere (Millière); March, 1866, at Malta (Mathew); from March-May, 1866, at Rome; June, 1866, at Florence; July, 1866, at Como (F. B. White); May 16th, 1872, at Marseilles; June 11th-17th, 1872, at Naples; July 1st, 1872, at the baths of Lucca; July 12th, 1872, at Bellagio (F. Walker); July 9th, 1887, at Vernet (Elwes); very common at Turin, July, 1878 (Swinton); May 31st, 1884, at Syracuse; June 27th, 1884, at Catania; June 30th, 1884, at Ætna; July 23rd, 1884, at Messina (also March 16th, 1884, at Messina) (Zeller, British Museum Collection); June 5th-20th, 1890, at Digne (A. H. Jones); May 30th, 1893, at Ajaccio (Standen); June 22nd, July 16th, August 6th, 1893, in Corsica (Yerbury); May 1st-7th, 1894, at Digne; July 7th-17th, 1894, at Vernet-les-Bains (Nicholson); April 10th, 1896, at Florence; April 12th, 1896, at Lugano (Rowland-Brown); July 19th-23rd, 1896, at Tancarville (Leech); March, 1897, and July 14th, 1897, at Malta (Mathew); March, 1897, at Cannes (Chapman); April 16th-21st, 1897, just appearing at Digne (Tutt); April 28th-May 10th, 1897, at Hyères (Buckmaster); June 18th-26th, 1897, at Fontainebleau; July 29th-August 4th, 1897, at St. Michel-de-Maurienne; August 11th-20th, 1897, at Susa (Tutt); March 6th, 1898, at Hyères (Yerbury); May 5th, 1898, at Hyères (Rowland-Brown); June 22nd, 1898, at Susa (Brown); July 28th-August 2nd, 1898, at

Bourg St. Maurice; August 3rd, 1898, from 500ft.-1000ft. above the highest point of the Little St. Bernard Pass; August 5th-12th, 1898, at Pré St. Didier; August 14th-15th, 1898, at Aosta (Tutt); February 24th, 1899, at La Bocca; March 12th, 1899, at Grasse; April 6th-20th, 1899, at Locarno (Chapman); May 19th, 1899, at Val André (Turner); June 16th, 1899, near the Pont du Gard; June 18th-23rd, 1899, at Digne; June 25th, 1899, at Nice; June 28th-July 7th, 1899, at St. Martin Vésubie; July 9th-14th, 1899, at Corsica—Vizzavona, Bastia; July 17th, 1899, at Annot, in the Basses-Alps (Lang); July 1st, 22nd, 1899, at Fusio (Chapman); fairly common at Orta, middle of May, 1900 (Lowe); August 1st, 1900, at Gardone (A. H. Jones); September 2nd-14th, 1900, at Rennes (Oberthür); February 27th, 1901, at Cannes (Chapman); July 31st-August 9th, 1901, at Torre Pellice and Crissolo; August 9th-18th, 1901, at Bobbie (Tutt); July 16th-August 5th, 1901, in the Cevennes—Florac, etc.; March 31st, 1902, at the Pont du Gard (Rowland-Brown); June 23rd-28th, 1902, at the Certosa di Pesio (Lowe); August 3rd, 1902, at Hesdin (Rowland-Brown); October 9th, 1902, at Beaulieu; October 17th, 1902, at Digne (Rowland-Brown); March 28th-April 2nd, 1903, at Hyères; April 6th-10th, 1903, at Pegomas and Auribeau; April 8th, 11th, 1903, at Agay; April 13th, 1903, at Albenga (Tutt); April 11th, 1903, at Menaggio (Sich); April 20th, 1903, at Locarno (Tutt); April 27th, May 11th, 1903, at Remoulins (Sheldon); late May, and August 11th, 1903, at Val André, in Brittany (Turner); July 12th-24th, 1903, in Corsica; July 26th, 1903, at St. Martin Vésubie (Rowland-Brown); April 24th-May 1st, 1905, at Hyères (Tutt); June 17th-27th, 1905, at Vernet-les-Bains (A. H. Jones); July 10th, 1905, also at Le Vernet (Rowland-Brown); August 21st, 1905, at Stresa (Tutt). In the most south-western portion of its area we have: Very abundant February and March at Tangier (Blackmore); April 23rd-30th, 1880, at Cintra; May 13th, 1880, between São Barnabe and São Bartholomeu do Messines (Eaton); June 12th, 1880, at Palmas, in the Canary Islands (British Museum Collection); December 17th-18th, 1881, at Laguna, Teneriffe (Mathew); May 10th-16th, 1882, at Philippeville (Elwes); February, 1885, common, at Lambessa (Bethune-Baker); throughout May, 1890, at Madeira (Mathew); June 1st, 1895, at Ronda (*eleus*) (Nicholson); February 5th-March 3rd, 1896, at Cintra (Yerbury); June 23rd-24th, 1900, at Mont Sèny, Catalonia (Witty); December 3rd-5th, 1900; March 15th-21st, 1901; April 3rd, 1901, at Tangier; May 18th, 1901, at Rasdouna; June 10th, 1901, at Marrakesh; throughout August-September, 1901, at Tangier; July 18th, 1901, at Imentalla, in the Atlas mountains (Meade-Waldo); July 3rd-22nd, 1904, at Puerto de Pajares; July 28th-August 6th, 1901, at Albarracin; August 3rd-5th, 1902, at Bronchales (Chapman); end of December, 1901, to middle of March, 1902, at Teneriffe, everywhere (Elliott); March 15th-18th, 1902, at Jerez de la Frontera (Lang); October 27th, 1902, at Granada (typical form) (A. H. Jones); July 12th-24th, 1903, at Moncayo (Chapman); March 7th, 1904, at Teneriffe (Crawshay); May 30th-31st, 1905, at Barcelona (Standen), etc. Of the dates, from more eastern places we have: May 23rd, 1862, in Naxos, May 17th, 1865, at Attica (Merlin collection); April, 1885, in Galilee, May, 1885, in Lebanon (Pratt); July 9th-August 4th, 1895, throughout the Mendel and Campiglio

districts (Lemann); May 19th, and July 20th, 1896, at Jerusalem (Swinton); October 2nd, 1896, at Lemnos, October 6th and 23rd, 1896, at Salonica, June. 1897, at Canea and Suda Bay, August 4th and 12th, 1897, at Malta (Mathew); July 18th. 1897, at Wolfsberg (Lemann); June 15th, 1898, at Beyrout (Mathew); July 9th, 1898, at Blagaj, May 21st, 1899, in the valley of the Ister, June 12th-26th, 1899, in the Rilska Valley, July 30th, 1899, at Rilo, April 30th, May 2nd, 1900, at Brummana (Nicholl); May 18th, 1900, in Morea (Elwes); July 12th, 1900, at Herculesbad (Lang); July 27th, 1900, on the Brenner Pass (Rowland-Brown); April 12th, 1901, at Malta, April 20th, 1901, at Corfu (T. B. Fletcher); July 2nd, 1904, at Trient (Keynes); July 10th, 1904, at Ain Zahalta, August 7th, 1904, at the mouth of the Dog River, near Beyrout, May 11th. 1905, near Jaffa, May 18th, 1905, near Damascus. May 28th-30th, 1905, in the Zebedani district, May 29th, 1905, at Baalbek (Graves), etc. In Switzerland, Frey says that it occurs from April-July. and August-September; Wheeler says that his earliest specimen was taken at Veytaux, the first week in May, 1899. Other notes are: August 13th, 1872, at Amsteg (Lang); July, 1885, at Disentis (Lemann); June 1st, 1886, at Brunnen (Jones); August 1st, 1894, at Saas-Fée (Rowland-Brown); August 6th, 1897, August 1st, 1898, at Bérisal (Wheeler); July 12th, 1898, at Fusio (Chapman); July 1st-13th, 1899, at St. Niklaus (Rosa); August 25th-September 7th, 1899. in the Lucerne district (Sanford); July 2nd, 1900, at Davos (Sloper); July 5th-30th, 1902, at Villars (Moss); August 19th, 1902, at Chamonix (Tutt); July 21st, 1903, at Bérisal (A. H. Jones); August 17th, 1903, at Chamonix (Tutt); July 15th, 1904, at Bellinzona, July 23rd, 1904, at Roveredo (Wheeler); July 23rd, 1904, at Basle, August 5th-7th, 1904, in the Saasthal, August 25th, 1905, at La Bâtiaz (Tutt), etc. In the Channel Isles we have: Early broods not abundant, fairly common in September. in Guernsey (Lowe); August 21st-28th, 1886, in Jersey (Jordan); May 28th, 1887, at Ferman Bay and Moulin Hoult Bay (F. A. Walker); June 14th, 1887, at St. Peter's, Guernsey (Hawes); April 24th, 1893, on the "Gouffre," Guernsey (Hodges); April 18th, 1898, in Guernsey (Lowe); one in May, another July 13th, and again August 10th, 1899, in Alderney (Luff). In the Baltic Provinces it is double-brooded, occurring from early May into June, and then from early August into September (Nolcken). In Scandinavia, at Saeterstoen, June 20th-July 2nd, 1898 (Chapman); June 18th-28th, July 9th, 1900, at Flodmark (Morton). As to its time of appearance in Britain, Lewin made it triple-brooded, one brood appearing in late April (the produce, Lewin wrongly says, of chrysalids that have survived the severity of winter), the latter end of June sees the appearance of a second brood, and at the latter end of August a third brood is flying. Curtis says, on the authority of Dale, that there are three broods appearing in succession from the beginning of April to November. Stephens, like Lewin, makes it triple-brooded, the broods occurring respectively in April, June, and August. Dale himself records the latest dates in his own and father's diaries to be November 5th, 1803, and November 8th, 1876, and the earliest April 2nd, 1833, and April 22nd, 1893 (*Ent.*, 1900, p. 351). Even as far north as Durham, Harrison notes it as triple-brooded, occurring in June, September, and a partial brood in October and November (*Ent. Rec.*, xvii., p. 254), whilst, in Essex, Raynor says that

in warm summers there is a third brood, emerging from the middle of September to the middle of October, *e.g.*, 1900. Dalglish says there are three broods in the Clyde basin, the first in May, the last in October, the earliest recorded dates for the district being May 15th, 1891, and May 19th, 1900, the latest October 3rd, 1896. Other dates noted are, May 30th, 1857, at Southampton (Swinton); July 7th-8th, 1870, just appearing at Bolt Head (Mathew); May 20th, 1871, at Wanstead (Burrows); May 25th, 1872, at Monk's Wood (Raynor); April 22nd, 1874, at Dry Drayton (Walker); July 18th, 1876, at Abbott's Wood (Dale); August 2nd, 1876, near Beachy Head (Sich); August 6th, 1877, at Chislehurst (Bower); August 20th-September 1st, 1877, at Tresco (Crewe); May 11th, 1878, at Mottingham; July 14th, 1878, at Brandon (Bower); May 30th, 1878, in the Rugby district; May 24th, 1879, in the Rugby district (Napier); August, 1879, at Tresco (Norgate); August 24th, 1879, at Yarmouth and Lowestoft (Lockyer); first seen in the year, September 10th, 1879, at Maldon (Fitch); August, 1880, at Dover (Gowland); July 27th, 1881, in the Isle of Purbeck (Bankes); May 7th, 1882, at Bexley (Bower); August, 1882, at Truro (Benson); August 7th, 1882, between Witley and Farnham (Oldfield); September 16th and 23rd, 1882, at Folkestone (Hall); May 23rd, 1886; May 23rd, July 14th, August 4th, 5th, 27th, 1887, in the Isle of Purbeck (Bankes); July, 1887, in Argyleshire (F. A. Walker); July 20th-August 10th, 1887, in the Chepstow district (Ince); August 1st-20th, 1887, abundant on the Deal sandhills (Tutt); August 6th, 1887, at Beckenham (Reid); June 13th, 1888, in the Isle of Purbeck (Bankes); June 23rd, 1888, in Delamere Forest (Arkle); August 23rd, 1888, between Wimborne and Blandford (Ward); September 18th, 1888, at Sandy (Hill); June 5th, August 12th-31st, 1889, in the Isle of Purbeck (Bankes); June 22nd, 1889, in Delamere Forest; July 15th, 1890, between Aberdovey and Glandovey (Arkle); August 12th, 1890, at Ramsey, Isle of Man (Jäger); August 15th, September 11th, 1890, in the Isle of Purbeck (Bankes); August 29th, 1890, at Newlyn (Burrows); May 30th, 1891, at Great Leigh; September 9th, 1891, at Loughton (Burrows); August 11th, 1891, at Andreas, Isle of Man (Clarke); August 15th, September 8th, 1891, in the Isle of Purbeck (Bankes); egg deposited August 28th, 1891, at Finchley, larva pupated October 2nd, 1891, imago October 25th, 1891 (Hawes); another imago emerged November 12th, 1891, having taken three months to complete its life cycle from the time the egg was laid (Hawes); May 20th, 1892, at Shoeburyness (Bower); May 21st-June 7th, 1892, in the New Forest (Ridley); May 31st, 1892, at Langworth (Raynor); June 2nd-12th, 1892, in Abbott's Wood (Tugwell); June 18th-26th, 1892, at Folkestone (James); July 1st-14th, 1892, at Salcombe (Prideaux); July 27th-August 17th, 1892, in Wicken Fen (Tutt); July 29th, 1892, at Witherslack (Arkle); August 10th, 1892, at Rainham; August 26th, 1892, at Southend (Burrows); August 10th, 17th, 1892, in the Isle of Purbeck (Bankes); last week in September, 1892, at Hastings (Bird); exceedingly abundant in 1893, from April to October, the hot dry summer evidently suited this species (Tutt); April 15th, 1893, at Tonbridge (Turner); April 18th, 1893, in the Wye valley (Nesbitt); April 18th, 1893, at Southend (Battley); April 18th, 1893, at Instow (Mathew); April 19th, 1893, at Instow (Hinchliff); April 20th, 1893, at Forest Row; May 13th, 1893,

at Horsley (Turner); April 21st, 1893, at Abbott's Wood (Esam); April 22nd, 1893, at High Beech (Freir); April 22nd, 1893, at Blackpool (Stones); April 22nd, 1893, at Woking (S. G. C. Russell); April 23rd, 1893, onward, in every month except May up to October 29th, at Painswick (Watkins); April 25th, July 7th, August 29th, September 3rd, 1893, all at Chiswick; July 17th, 1893, St. James' Street, London; August 24th, 1893, at Hastings (Sich); April 27th, 1893, at Lee (Bower); May 6th, 1893, at Harrow Weald (Rowland-Brown); May 21st, 1893, at Brockenhurst (Tremayne); July 3rd, August 25th, 26th, 29th, September 15th, 1893, Isle of Purbeck (Bankes); July 6th, 1893, at Monkswood (Blake); July 10th, 1893, at Morthoe (Sheldon); July 22nd, August 22nd, 1893, at Cuxton, imago emerged November 2nd, 1893, from pupa received from Guernsey in October (Tutt); July 27th-31st, 1893, in Wicken Fen (Bouskell); August 7th, 1893, near Findhorn (Mutch); August 18th, 1893, at Walthamstow; August 28th, 1893, at Swanage (Freir); May 6th, 1893, at Harrow Weald (Rowland-Brown); May 21st, 1893, at Brockenhurst (Tremayne); September 1st-20th, 1893, at Tenby (Meynell); September 5th-6th, 1893, in profusion, near Balham (Frohawk); September 7th, 1893, near Dartford (Sabine); third brood near Birmingham, September, 1893 (Bath); September 19th-October 5th, 1893, at Dawlish (Tremayne); September 20th, 1893, at Lochearnhead (Rowland-Brown); October 16th, 1893, at Panton (Raynor); last specimen seen, newly emerged, November 1st, 1893, at Micheldean (Searancke); a late brood at Ringwood, did not emerge till November 12th, 1893 (Fowler); April 19th, 1894, at Salcombe (Turner); April 30th, 1894, at Ashtead (Prideaux); May 7th-mid-October, 1894, at Harrow Weald (Rowland-Brown); May 12th, 1894, in the Isle of Purbeck (Bankes); May 24th, 1894, at Hartsholme (Raynor); July 10th-25th, 1894, at Stonehaven (Dalglish); August 14th, 1894, at Rainham (Burrows); August 15th, 1894, at Swanage (Bromilow); August 25th, 1894, at Douglas (Mackonochie); September 23rd, 1894, at Pett (Bird); earliest date noted at Ashford, May 4th, 1895 (Wood); May 9th-October 17th, 1895, in the Isle of Wight (Prideaux); May 23rd, 1895, at Rainham (Burrows); May 29th, 1895, at Mottingham; August 15th, 1895, common at Lee (Bower); May 1st-12th, 1896, at Hereford (Chapman); May 6th, 1896, earliest date noticed in Stroud (Davis); May 17th, 1896, at Lezayre (Clarke); May 23rd, 1896, in Epping Forest (Simes); May 25th and 27th, 1896, at Langworth (Raynor); July 12th, 1896, at Old Hall, near Ipswich (Frost); August 3rd, 1896, at Tunbridge Wells (Tremayne); September 29th, 1896, at Chiswick (Sich); May 21st, 1897, two at Dartford Heath (Bower); May 24th, 1897, at Woodham Ferris, August 2nd, 1897, at Hazeleigh (Raynor); August 2nd, 1897, at Shere (Tremayne); May 21st-28th, 1897, at Laugharne (Jefferys); May 27th, August 11th, 1898, at Hazeleigh (Raynor); June 22nd, 1897, at Gourock (Dalglish); July 20th, October 9th, 1897, at Bentley (Burrows); October 18th, 1897, at Truro (Rollason); October 21st, 1897, one very fine at Hazeleigh (Raynor); May 28th, 1898, at Laugharne (Jefferys); August 20th, 1898, at Shoreham (Bower); August 25th, 1898, at Greenhithe (Image); August 31st, 1898, at Fulmer (Bird); specimen as late as October 13th, 1898, at Erith (Sabine); July 29th, 1899, at Shipley; September 13th, 15th, 1899, at Oxshott (Bird); July 28th, 1899, very abundant on the Sussex Downs

(Frohawk); August 1st-September 11th, 1899, at Swanage (Kemp); August 8th, 1899, at Hazeleigh (Raynor); August 12th, 1899, at Irvine (Dalglish); August 6th-9th, 1899, at Hailsham (Carr); August 10th, 1899, in the Shotwich district (Arkle); latest date noted in Stroud, September 4th, 1899 (Davis); September 5th, 1899, into October, at Llanstephan (Bingham-Newland); abundant September, 1899, in Devonshire (Jefferys); September 9th, 1899, at Broxbourne (Gardner); May 14th, 1900, at Mottingham (Bower); May 19th, 1900, near Ayr; August 4th-20th, 1900, at King's Cross, Arran; September 23rd, 1900, at Gourock (Dalglish); May 31st, 1900, at Wye; August 7th, 1900, at Hazeleigh (Raynor); June 9th-14th, 1900, at Eynsford (Barraud); June 11th, 1900, at Polegate (Blenkarn); June 4th, 1900, at Westwell; September 15th, 1900, in Epping Forest (Gardner); August 9th-17th, 1900, at Weston-super-Mare (Whittaker); August 11th-27th, 1900, at Folkestone (Pickett); August 14th, 1900, at Sheerness (Fletcher): August 20th, 1900, at Fulmer (Bird); August 25th, 1900, at Dartmouth (Bankes); September 21st, 1900, on Wimbledon Common (Bishop); November 2nd, 1901, at Seaton (Eaton); November 3rd, 1900, at Truro (Rollason); May 27th, 1901, in Sandburn Wood (Walker); May 20th, 1901, at Cowfold (Bird); May 29th, 1901, at Hazeleigh (Raynor); May-to mid-July, and again in mid-August-September 29th, 1901, at Dorking (Oldaker); July 20th and September 14th, 1901, at Wakering (Whittle); August 2nd-September 10th, 1901, at Burgess Hill (Dollman); August 9th-19th, 1901, at Porlock (Carr); August 19th-20th, 1901, at Lynton (Oldaker); August 30th, 1901, at Dartmouth (Bankes); September 20th, 1901, at Westwell; October 12th, 1901, in Epping Forest (Gardner); September 30th, 1901, at Harrow Weald (Rowland-Brown); October 23rd, 1901, at Clevedon (Jefferys); May 25th, August 19th, 1902, at Hazeleigh (Raynor); May 31st, 1902, at Dorking (Oldaker); May 30th-June 2nd, 1902, at Brockenhurst (Barraud); August 1st-12th, at Brockenhurst (White); August 1st-September 13th, 1902, at Burgess Hill (Dollman); August 10th-24th, 1902, at Deal (Browne); August 1st, 1902, in the Isle of Purbeck (Bankes); August 21st, 1902, at Forres (Gardner); August 21st, 1902, at Mucking; August 27th, 1902, at Cuxton (Burrows); August 22nd, 1902, at Cowfold (Bird); August 23rd, 1902, at Harrow Weald, common; August 24th, 1902, on Stanmore Common; September 6th, 1902, on Box Hill (Barraud); May 26th, 1902, at Shoreham; October 8th, 1902, in poor condition, at Chislehurst (Bower); June 25th, 1902, at Deal (Carr); June 2nd, 1902, September 7th, 1902, at Colesborne (Elwes); October 8th, 1902, at Salisbury (Carr); May 6th-October 29th, 1903, at Harrow Weald (Rowland-Brown); May 28th, August 22nd, 1903, in the Isle of Purbeck (Bankes); May 30th, 1903, at Mucking; June 30th, 1903, at Tuddenham; August 12th-21st. 1903, at Bentley (Burrows); May 30th-June 1st, 1903, at Brockenhurst (Barraud); June 29th, 1903, at Hazeleigh (Raynor); July 29th, 1903, on Exmoor; September 16th, 1903, in Epping Forest (Gardner); August 1st-14th, 1903, at Brockenhurst (Wright); August 6th-21st, 1903, at Storrington (Bird); August 12th, 1903, at Folkestone (Pickett); August 8th, 1903, near Bognor (Oldaker); September 23rd, 1903, at Chislehurst (Bower); June, 1904, in the New Forest (Barraud); August 5th-September 3rd, 1904, at Tintern and Llandogo (Bird); August 7th, 8th, 1904, in the Isle of Purbeck (Bankes); August 8th,

1904, at Hazeleigh (Raynor); August 21st, 1904, at Benfleet (Whittle); August 27th, 1904, in Epping Forest (Gardner); October 15th, 1904, at Hazeleigh; October 20th, 1904, at Danbury (Raynor); May 21st, 1905, common near Carmarthen (Barker); May 26th-30th, 1905, at Aldeburgh; August 19th, 1905, at Loughton (Image); May 30th and July 24th, 1905, at Hazeleigh (Raynor); May 31st, June 3rd, 10th, 22nd, July 28th, August 8th, 14th, 17th, 1905, at Tintern and Llandogo (Bird); June 28th-October 9th, 1905, at Mucking (Burrows); August 5th, 1905, on Aldbury Down (Barraud); August 6th, 1905, at Shoeburyness (Whittle); August 12th, 1905, at Abertillery (Rait-Smith); latest date noted at Ashford, September 8th, 1905 (Wood): April 19th, 1906, at Reigate (W. N. Jups); dates for 1906 in the Tintern district, first brood (?)—May 15th, June 3rd, 5th, 8th, 9th, 12th, 13th; second brood (?)—August 6th, 8th, 9th, 11th, 12th, 16th, 18th, 20th, 21st, 22nd, 23rd, 29th, 30th, September 1st (J. F. Bird); June 8th, earliest seen of first brood, July 25th, 1906, earliest seen of second brood, September 18th, 1906, latest seen of second brood, all at Hazeleigh; September 20th, 1906, earliest seen of the third brood, at Danbury (Raynor); August 4th, 1906, on Wimbledon Common (Smallman); October 11th, 1906, common at Mucking (Burrows).

Habits.—In addition to the notes published by Gosse (*anteà*, p. 346), concerning the pairing habits of this species, Harrison notes (*Ent. Rec.*, xvii., p. 254) that the species pairs at about 11 a.m. On one occasion a ♀ was observed to alight on a thistle-plant (without flowers). It raised its abdomen and vibrated its wings, standing in such a position that the head was furthest from the ground. A ♂ soon appeared and alighted beneath the ♀, its head being in the same direction; the ♀ appeared to be rather coy; the ♂ turned his abdomen nearly parallel to the thorax, when the ♀ moved further up the stem and repeated the process. This took place three times, and then copulation took place. Another pair was found *in copulâ*, on a flower-head of ragwort; the wings remained partly opened and both specimens were probing flowers. These two pairs remained *in copulà* about 65 minutes. Farn says: "A sheltered corner of a field, on September 7th, 1868, where a quantity of thistles grew, appeared to be the rendezvous of *C. phlaeas*, as both ♂s and ♀s were in abundance, and I observed that, if a flirtation between any two was likely to end in the more material object, that of propagating the species, they quitted the assemblage and retired to some distance, and I also noticed that the ♀s, whilst depositing their eggs, avoided that part where *C. phlaeas* congregated most, although the sorrel grew in greater abundance there than elsewhere." The butterfly is a most active little creature, alighting on a roadside-bank, or flower, to sun itself, or flitting restlessly from flower to flower, quarrelling occasionally with other individuals of its own kind, or fearlessly attacking much larger species; occasionally it chooses a leaf by a hedgeside or wood-riding, and we have seen it thus resting on hazel, dogwood, and other bushes, walking slowly round, dropping its hindwings lower than its forewings, and bringing itself to a standstill in such a position that the sun falls full on its richly glowing wings. But the insect can be still enough, and, having settled on a flower, whose nectar delights it, it draws up its wings closely over its back and is soon almost without knowledge of its surroundings. Smith observes that, in Norfolk, it flashes about in

much the same fashion as the "blues," without being quite so exploring, the flights seem to be shorter and more rushing, and it will often drive away an insect larger than itself. In the alpine valleys of central Europe it occasionally visits the runnels by the wayside, with the numerous other species found in such situations, but its visits are rare, even more so than those of *Heodes virgaureae*, which also is never attracted to the same extent as are the "blues," Erebiids, and some "skippers." Mathew observes that, on one occasion, he visited the Island of Pachalimon, one of a group in the Sea of Marmora, and the immense swarms of *phlaeas* there were very remarkable. It was a terribly hot day, and the butterflies had collected in shady spots in the ravines where the sun could not penetrate; a blow with a beating-stick brought them out of the bushes by hundreds, and he had often more than a dozen in his net at a time. The examples were very dark of the *eleus* form. It is, however, as a rule, a lover of the sun, and Swinton observes that, at Jerusalem, the insect haunts the roadsides, flying away and returning to settle on the sunny ground or the wall of a vineyard. In Britain it is certainly an active insect, haunting flowers of various kinds, *e.g.*, *Thymus serpyllum*, at Cuxton (Tutt), *Eupatorium cannabinum*, at Tintern (J. F. Bird), sea-holly, in company with *Pyrameis cardui* and *Plusia gamma*, on the sand-dunes of Yarmouth and Lowestoft (Lockyer), flowers of scabious at Abertillery (Rait-Smith), lavender at Clevedon (Mason), etc. We have seen as many as a dozen or a score on a single small patch of thyme in full blossom in early August, at Cuxton and Halling. Smallman observes (*in litt.*) that, "unlike *Polyommatus icarus*, *R. phlaeas* is found as commonly in the garden as in the meadow, and it is found at almost all flowers, especially those belonging to the *Compositae*. *R. phlaeas* has a much stronger flight than *P. icarus*, and is, therefore, much more difficult to catch, but when it settles it often remains on the same flower for two or three minutes at a stretch. This species usually settles on the upper flowers or on the top of the grass unless the sun is obscured when it generally settles close to the ground, still, one may often find it sunning itself on a closely-cut lawn or on gravel paths, in which latter position it is very difficult to see when it has its wings closed. This butterfly invariably settles with its head higher than, or on the same level as, the rest of its body and with the wings fairly well open, the latter being kept at about an angle of 135° with each other, whilst the antennæ are kept parallel with the wings. The head is usually kept directly away from the sun, but, when feeding, this butterfly has a habit of slowly turning round and round on a flower, and always, as far as my observations go, from right to left. Although the wings are usually kept at an angle of 135° with each other, still one often sees specimens with the wings more closed, and the butterfly at times slowly opens and shuts its wings when settled. When the wings are widely opened, as mentioned above, the hind margins of the hindwings are wrapped round the body and the forewings are kept very forward, so that there is a considerable space between the fore- and hindwings, but the more erect the wings are kept the less space there is between the fore- and hindwings. Like *P. icarus*, *R. phlaeas* usually closes its wings on the sun going behind a cloud." Watching an example sunning itself on a clump of what looked like a white-flowered marjoram in full bloom, at Digne, in mid-August, 1906, we observed

that, so soon as it settled, it sidled round till its back was to the sun, the latter shining fully upon it; it then opened its forewings, each falling through an angle of about 45°, dropping, however, its hindwings still lower, possibly at about 60°, so that the forewings rarely fell as low as the hindwings whilst thus engaged; it also loved, in the torrent beds there, to explore a head of *Eupatorium* when sunning, and its appearance then is very different from that when it is feeding or preparing for sleep, when, with the underside of its hindwings only visible, its brilliant tints are entirely hidden from view. We have already noted that, occasionally, it rests on leaves in preference to flowers, *e.g.*, in a rough, overgrown, thistly field, near Digne, in August, 1906, the ♂s walked about and sunned themselves on the leaves, and Raynor notes that, on October 15th, 1904, a sunny, but cold, day, he saw a specimen of *R. phlaeas* fly up from the ground and settle on an oak-leaf (about three feet from the ground). Its habit of early rising has repeatedly been noted. Freir observes (*Ent.*, xxvii., p. 135) that, on August 18th, 1893, he saw fully two dozen flying about one flower-bed at 6.15 a.m., at Walthamstow, the morning already extremely hot and dry, the mean temperature at the time 72°F. Chapman observes that, in July 1898, at Bossekop, it was often seen on the wing as early as 8 a.m. (*Ent. Mo. Mag.*, xxxv., p. 28). At Tromsö, Schneider says that its flight is extremely shy and erratic, and, as it haunts districts that are difficult to negotiate, it is not easily taken. Here, too, it has a long period of flight, being observed as early as June 21st (in 1883 and 1890), and as late as September 8th (1891), but the specimens certainly all, he says, belong to one long brood. It haunts the flowers of *Lotus* and *Vicia*, and is also fond of sunning itself by the roadsides on heaps of stones. On the Island of Huko, several specimens were observed on July 21st, 1891, with *P. icarus*, sucking nectar from the flowers of *Lotus*. Strand states that there are distinct differences in habit between the arctic and southern *phlaeas*, and speaks of the southern insect as a quiet, almost sluggish, insect, flying in meadows, etc., whilst, in the far north, it is very shy and wild, and haunts rocky and almost inaccessible places. It has never struck us that *phlaeas* was a particularly sluggish and innocent insect. Glaser says that, in Germany, the butterfly likes to run on roads, or to visit flowers; *Thymus serpyllum*, etc. It walks about boldly, sucking the nectar, and may then be captured with the fingers. In Anhalt, the butterfly often rests on the ground, opening its wings fully in the sunshine, or sits with closed wings on the flowers, sucking the nectar thereof; the butterfly has a pretty rapid flight (Gillmer). In England, the species varies greatly in its abundance and rarity in different years. In 1887 and 1893, it was very generally abundant, even in places where it usually is comparatively rare and only occasionally met with. Regarding this, Hawes says (*Proc. Sth. Lond. Ent. Soc.*, 1893, p. 136) that, after *phlaeas* had become comparatively rare in Britain, it slowly gained ground, until, in 1893, it was extraordinarily abundant. In that year, in the Finchley district, the first brood appeared abnormally early, being well out at the beginning of May (specimens were seen commonly in April), the second brood was on the wing about July 10th (or fully three weeks before the usual time). This brood, which is the most regular as to time and numbers, scarcely ever fails to put in an appearance during the first week in August; but, this year, many of the larvæ

from the July imagines were fullgrown, and the third brood began to emerge during the last week of August, and was well out early in September, in fact, except for a slight lull at the beginning of August, specimens were to be seen throughout the summer, every day visiting the flowers in gardens, fighting in pairs in the streets, often being carried away on the wind, but chiefly congregating in favoured rough corners and lanes, and the banks of the railway, where the early morning sun seems especially to have drawn them out into full flight before 9 a.m." This was pretty generally the case all over the southern parts of the British Islands in this year, and, in October, 1893, another almost full emergence took place, the specimens appearing, indeed, well on into November. The dry, hot spring and summer of 1893 were evidently distinctly favourable to the development of *phlaeas*. Newman notes the species as excessively abundant at the end of September, 1868, and observes that he never saw so many specimens together as on September 30th, at Elm Hall, Wanstead; a bed of verbenas seemed a great attraction to them. We have already noted Scudder's remarks (*anteà*, pp. 346-7) on the resting-postures of this butterfly, and its sleeping-habits, as recounted by Miss Soule (*op. cit.*). On the same subject, Smallman writes (*in litt.*): "Whilst observing the sleeping-habits of *P. icarus*, in early August, 1906, on Wimbledon Common, a few examples of *R. phlaeas* were also noticed on the dead heads of *Serratula tinctoria*, but, although *R. phlaeas* is distinctly commoner than *P. icarus* here, I was only able to find two or three specimens asleep, so I assume they do not, as a rule, sleep on the dead heads of *S. tinctoria*, or on the grass. This butterfly sleeps head downwards, wings closed, the forewings almost completely hidden by hindwings, except the tips; the antennæ held in a line with the body, and at an angle of about 45° with each other. This species had also ceased to fly at 5.40 p.m." Although one of the earliest of the newly-emerging species to be seen on the wing in the spring, it is also, in Britain, the last non-hybernating butterfly to be seen on the approach of winter.

Habitat.—It is difficult to say what are the chosen haunts of this lovely little insect, yet one may not write "everywhere" against it, for there are many spots where a specimen may never be seen. Distributed as it is, from the Atlantic to the Pacific, in both the Old and New Worlds, and from the warmest north temperate regions to far within the Arctic circle, and from the low hot plains of southern Europe and Asia, up the mountains to an elevation of from 8000ft. (in the Basses-Alpes) to 15000ft. (in northeast Kumoa), it yet selects its chosen places in which to live, and as, in America, it is said to prefer dry, sandy or gravelly, barren spots, or the sides of paths in dry pastures or upland highways, frequently invading towns and finding the hottest corners for its gambols, so, in Europe, it selects sandhills and sand-dunes, sloping chalkhills and flowery wayside banks, meadows, wood-ridings, heaths and moorlands, mountain pasturages, and other innumerably different spots. In Britain, it loves our open chalkhills in the southern and eastern counties, the limestone slopes of the western and northern counties, the sandstone of the south-western, etc., *e.g.*, the downs at Halling (Ovenden), and at Freshwater (Hawes), the sandhills at Deal (Tutt), and near Findhorn (Mutch), especially abundant on the dry Triassic sandstone area of the central and northern parts of Nottingham (Goss); the

heaths at Newbury (Kimber), the moorlands of the western Highlands (Tutt), rough stony ground edging the woods near Truro, and at Weston-super-Mare (Whittaker), whilst fine bright examples occur in the Isles of Bute and the Great Cumbrae (Swinton), and so on. Donovan says that it is very common in almost every field and meadow, delighting in sunny situations, by the hedges on roadsides, much-frequented footpaths, &c. Lewin says it is abundant in almost every place where grass grows. Curtis notes it as occurring almost everywhere in England and different parts of Scotland, on heaths, grassy commons, banks, and roadsides. Stephens says that it frequents commons, pastures, roadsides, heaths, and marshy places. In Ireland it is common in woods, fields of clover and lucerne, and warm sunny roadsides, etc. (Kane), and, in Guernsey, it haunts "The Gouffre," the slopes of which, in April, 1893, were covered with gorse and dog-daisies (Hodges). Schneider says that, at Tromsö, the butterfly inhabits most difficult country, *e.g.*, the steepest banks in the Tromsdal, its most favoured haunt here being the flowering southern extremity of the island of Tromsö, which it shares with *Polyommatus icarus*, resting on the flowers of *Lotus corniculatus* and *Vicia*, growing in rocky places. Above the Floifjeld it was seen on July 12th, 1883, at a height of about 300 metres. Although distributed over the Arctic region of Scandinavia, Schneider thinks it is mostly confined to the coast districts. Strand says that, in the Suldal, the species occurred very commonly on dry, sun-heated, stone-covered slopes, in 1901. In France, the chosen spots are much as in Britain. Along the Riviera, the thyme-clad slopes of Provence and the Esterel, the lush meadows with their spring flowers lying by the sides of the turbulent water-courses, and the flower-clad banks by the roadsides; in central France the meadows and heaths on the outskirts of Fontainebleau Forest open up quite new ground, as also do the seaside sand-dunes on the coast of Brittany, and the sloping hillsides above the lovely Lac Bourget, near Grésy-sur-Aix; then there are also the weedy fallow-fields at Digne, and the marvellous ravine, with its turbulent stream flowing into the Eaux-Chaudes; the glorious flower-clad slopes in the mountain valleys of Bourg St. Maurice, and the steep stony road leading to the summit of the Little St. Bernard, as well as the mountain pastures 500ft.-1000ft. above; whilst in the Basses-Alpes, on the slopes, far up above the Lac d'Allos, the species occurred singly, up to 8000ft., as well as on the stony slopes, comparatively low down, between Allos and Colmars. In Germany, it occurs from the plains to the tree limit. In the Hartz also, it occurs, as well as on the higher mountains, up to the alpine region, though most common from 1800ft. to 2500ft (Speyer). It is noted near Lübeck on light ground (Tessmann); in sandy places overgrown with *Rumex* along the eastern slope of the "Kleinen Hees," near Uerdingen (Stollwerck); common in fields and clearings in woods near Elberfeld and Barmen (Weymer); in dry sandy places near Neuenahr and Altenahr (Maassen); along the borders of the Sterger-wald and Willrodaerforst, on grassy slopes (Verein Erfurt); in meadows by roadsides and in woods at Dresden (Steinert); in meadows and roadsides at Chemnitz (Pabst); in sunny dry places, grassy outskirts of woods, banks by roadsides, etc., at Waldeck (Speyer); on the roadsides near Zeitz (Wilde); almost all dry places near Halle (Stange), and around Frankfort-on-Oder (Krets-

chmer); also along the sides of the dykes in the latter locality (Herrmann); on lawns and fallow fields near Munich (Kranz); on moorlands and mosses near Kempten (von Kolb). In Switzerland, it is widely distributed, but not generally common, except south of the Alps (Wheeler). In Italy, it occurs almost everywhere, on the mountains, woodlands, fields, and gardens, both on the mainland and the islands of Corsica, Sardinia, and Sicily (see *anteà*, p. 372). In the valleys of Piedmont it is often particularly abundant, *e.g.*, the flowery openings in the woodlands at Torre Pellice; the stone-covered slopes at Bobbie; the upland meadows and vineyards at Susa; the steep zigzags at Crissolo; whilst, in the vineyards and gardens on the slopes above Locarno, Lugano, and other delightful places, on the "lakes," it abounds. Throughout Tuscany it is to be found in gardens, fields, meadows, and woodlands, on plains, hills and mountains (Stefanelli). In Spain, it occurs on the Rock at Gibraltar, as well as the neighbouring Cork woods; the sierras of Albarracin; whilst Lang notes it as being found in a small forest of gigantic umbrella pines at Jerez de la Frontera, in Andalusia. In Bulgaria, Mrs. Nicholl records it on broken ground in the Rilska Valley, where granite blocks had rolled down from the precipices on a sheltered meadow at the foot of the woods, and overgrown with all kinds of flowering weeds, intersected by a tiny stream forming a sort of natural rockwork. In Palestine, it loves the hot steaming pathways intersecting the meadows and vineyards; whilst in Syria, it is found in all the pinewoods, covering the precipitous heights above Ain Zahalta; it haunts the wooded railway banks covered with flowering crucifers at Dumar, the dry open banks being much more prolific than the woods at Damascus (Graves); in Cilicia, it occurs in the coast districts and lower hills (Holtz). Of other habitats in the mountains of India, of China, and the Japanese Islands, as well as in Abyssinia and the Canary and Madeira Islands, we have already spoken. In the Pamirs it flies everywhere, but not above 4000ft., but on the Col Bëik it occurred at 14000ft. elevation (Grum-Grshimailo). Although occurring throughout Mauretania and the Levant, and extending to Abyssinia, it appears to miss Egypt, and Graves notes that though he has collected at Cairo, Alexandria, Aboukir, the Maryut district, Port Said, Helouan, Kalyub, and Gizeh, he has never seen *phlaeas*, nor heard of the insect as occurring there.

Localities.—Distributed throughout the British Islands from the Orkney Isles to the Scilly Isles, and from Kent to Galway. Kane says that it occurs throughout Ireland, more abundant in the northern counties. Aberdeen: coast districts (Esson), abundant throughout (Reid), Alford common (McLean), Pitcaple (Connon). Argyllshire: throughout (Dalglish), (F. A. Walker), Kilberry (Cottingham), Tayvallich (Swinton), Port Ellen—Islay (Branston-Jones). Arran and Bute: throughout—King's Cross (Dalglish), Island of Great Cumbrae in the Clyde, Ettrick Bay. Ayr: throughout (Dalglish). Banff (Brown). Beds: generally distributed (Barrett), Sandy (Hill), Bedford (Nash). Berks: common (V. C. H.), Newbury (Kimber). Brecknock (Jefferys). Bucks: Buckingham (Slade), Stony Stratford (Foddy), Fulmer (Bird), Chalfont St. Peter's (St. John), Chilterns, common—Kimble, Wendover district (Rowland-Brown). Cambridge: Wicken Fen (Bouskell), Boxworth (Thornhill), Cambridge (Crisp), Chatteris (Ruston), Ely (Archer). Carmarthen: Llanstephan (Bingham-Newland), Laugharne (Jefferys), common near Carmarthen (Barker). Carnarvon: Llandudno district (Harding), Conway Valley (Bland), Aber (Barraud). Cheshire: generally distributed and common (Day), Delamere Forest, Beeston Castle Hill (Arkle), Macclesfield (South). Cork:

Glandore, Timoleague, Courtmacsherry, Ummera Woods (Donovan). Cornwall: Polperro (Perrycoste), Newlyn, Penzance (Burrows), Truro (Rollason), Polzeath, near Padstow (Gibbs), Godolphin (Spiller), Scilly Isles (Adkin), Tresco (Norgate). Cumberland: common all over the county—Carlisle (F. H. Day), Silloth (Wilkinson), Keswick (Beadle). Denbigh: Colwyn Bay (Imms). Derby: generally distributed and common in south, scarcer towards north—Ashbourne (Jourdain), Bakewell (Fuller), Repton (Garneys), Bretby (Gibbs), Melbourne (Crewe), Kirk Langley (Fuller), Little Eaton (Hill), Heanor (Rhodes). Devon: common throughout the county—Bolt Head (Mathew), Instow (Hinchliff), Honiton (Riding), Paignton (Goodale), Dawlish (Tremayne), Dartmouth (Bankes), Exmoor (Gardner), Torquay (Crocker), Seaton (Eaton), Teignmouth (Rogers), Devonport, Lydford, Buckfastleigh (de la Garde), Torrington, most seasons scarce (Doidge), Silverton common (Ward), north Devon (South), Lynmouth (Briggs), Lynton (Oldaker), Morthoe (Longstaff), Sidmouth (Majendie), Salcombe (Turner). Donegal: north Donegal—Ards (Kane). Dorset: south Dorset generally abundant (Bogue), Wimborne, Hambledon Hill, and Hod's Hill (Fowler), halfway between Wimborne and Blandford (Ward), Sherborne (Douglas), Glanvilles Wootton (Dale), Lyme Regis (Charles), Swanage (Bromilow), Isle of Purbeck (Bankes). Dumbarton: throughout (Dalglish). Durham: generally distributed — Hartlepool (Robson), Sunderland (Corder), common at Stanley (Dewar), Durham (Harrison), Darlington (Backhouse), Redewater (Howse), Upper Teesdale (Lees), Finchale (Brady). Elgin: Strathspey (Gordon), Forres (Gardner), near Findhorn (Mutch). Essex: generally common, especially on the coast (Harwood), Walthamstow (Freir), Benfleet, Shoeburyness, Great Wakering (Whittle), Southend (Battley), Harwich district (Mathew), Brentwood, Rainham, Woodham Ferris, Danbury, Hazeleigh (Raynor), Loughton (Image), Epping Forest (Gardner), High Beech (Freir), Maldon (Fitch), Wanstead, Great Leighs, Mucking, Loughton (Burrows). Fife: Fife (Brown). Forfar: common (Duncan). Galway: Connemara (Birchall). Glamorgan: near Swansea (Robertson), Cardiff, fairly common, but only one specimen seen in 1903 (Shelley). Gloucester: common throughout (Griffiths), Cheltenham (Robertson), Micheldean (Searancke), Bristol (Allis), Stroud (Davis), Painswick (Watkins), on the Gloucester bank of the Avon, near Bristol (Gardiner). Hants: common throughout the county (Goss), Ringwood (Fowler), Isle of Wight (Prideaux), Ventnor (South), Shanklin (Leech), Freshwater (Hawes), Totland Bay (Rowland-Brown), Fleet (S. G. C. Russell), Brockenhurst (Tremayne), Lyndhurst (Lockyer), Forest of Bere (Hawker), New Forest (Ridley), Fort Rowner, Gosport (Mackett), Southampton (Swinton), Frensham district (Bingham-Newland), Winchester (Tomlin). Hereford: common.—Hereford (Chapman) etc. Herts: common in southwest Herts (Rowland-Brown), Broxbourne (Gardner), St. Albans and Harpenden (A. E. Gibbs), Bricket Wood (Perkins), Sandridge (Griffith), Hitchin (Durrant), Haileybury (Bowyer), Watford (Spencer), Aldbury Owers, Tring (Elliman), Bushey Heath (Barraud), Stevenage (Matthew), Cheshunt (Boyd), Rickmansworth (South). Hunts: Monkswood (Blake). Inverness: Strathglass (White). Isle of Man (Salvage): Andreas, Lezayre (Clarke), Ramsey (Jäger). Kent: generally common everywhere (Battley), Chatham and Rochester districts, Cuxton, Strood, Halling, Cliffe, Chattenden, Deal sandhills, St. Margaret's Bay, etc. (Tutt), Eynsford (Barraud), Cranbrook (Marshall), Sheerness (Fletcher), Chatham (Walker), Greenhithe (Image), Westwell (Gardner), Sevenoaks (Mrs. Holmes), Folkestone (Freke), Dover (Webb), Dartford (Sabine), Tonbridge, Brockley (Turner), Lower Fant, Maidstone (Golding), Ashford, Bexley Heath (Wood), Chislehurst, Mottingham, Lee, Dartford Heath, Shoreham (Bower), Wye (Raynor), Tunbridge Wells (Tremayne), Beckenham (Weir). Kincardine: common (Duncan), Stonehaven (Dalglish), coast districts (Esson), Muchalls (Reid). Lanark: throughout (Dalglish), Castle Douglas (Mackonochie). Lancashire: generally distributed and common (Day), abundant (Sharp), Prestwich (Melvill). Leicestershire: common throughout (Bouskell). Lincoln: Panton, Hartsholme, Castor, Langworth, Legsby (Raynor), Lincoln district (Carr), near Brigg (Cassal). Londonderry (Salvage). Middlesex: Kingsbury (Godwin), Great Stanmore (Rothschild), Chiswick (Sich), Harrow-Weald (Rowland-Brown), Highbury (Hodge), Mill Hill, Northwood, Harefield (South), near Enfield (Sykes), Stanmore Common (Barraud), Hammersmith, Acton, Ealing, Northolt, Northwood (Bird), Clapton (Bacot), Stamford Hill district (Prout), Isleworth (Fenn). Merioneth: between Aberdovey and Glandovey (Arkle), Tan-y-Bwlch

(Blagg), Barmouth (Imms). MIDLOTHIAN: Balerno (Carlier). MONMOUTH: Abertillery (Rait-Smith), Chepstow district (Ince), Tintern district, Llandogo (Bird), Monmouth (Palmer). MONAGHAN: abundant (Kane). MONTGOMERY (Tetley). NORFOLK: King's Lynn (Barrett), Yarmouth, Lowestoft (Lockyer), Downham Market (Smith), Hunstanton (Raynor). NORTHAMPTON: Northampton (Goss), near Oundle (Bree), Peterborough, Yaxley, Holme (Morley). NORTHUMBERLAND: generally distributed (Robson), Twizell (Selby), Newcastle (Backhouse). NOTTINGHAM: Nottingham district (Leivers). OXFORD: common all round Oxford (Geldart), Watlington (Lucas). PEEBLES: Peebles, common (Black). PEMBROKE: Castlemartin (Hodge), Tenby (Meynell). PERTH: Earn district, Forth district, Gowrie district, Perth district, Athole district (White), Lochearnhead (Rowland-Brown). RADNOR: Erwood district (Vaughan). RENFREW: throughout—Gourock (Dalglish). ROXBURGH (Douglas): Melrose (Beveridge). RUTLAND: Stoke Dry (Raynor). SELKIRK: Galashiels (Haggart). SHETLANDS AND ORKNEY: Hoy (McArthur). SHROPSHIRE: Ludlow (Blackmore). SOMERSET: common throughout (Griffiths), from Portishead to Burnham very general (A. P. Gardiner), in Leigh Woods, Bridlington (Gardiner), Taunton (Tetley), West Compton, very scarce (Bogue), Porlock (Carr), Clevedon (Jefferys), Weston-super-Mare (Whittaker), Castle Cary (Macmillan). STAFFS: common, Madeley (Daltry), Stafford (Freer), Burton (Brown), Tatenhill (Anderson), Cannock Chase (Thornewill), Chartley Park (Harris). STIRLING: throughout (Dalglish). SUFFOLK: common (Bloomfield), Stoke-by-Nayland, Stratford St. Mary (Mathew), Aldeburgh (Image), Needham Market (Raynor), Bentley, Tuddenham (Burrows), near Ipswich (Frost), Brandon (Bower). SURREY: generally distributed (Goss), Reigate, common (Tonge), Boxhill (Barraud), Wimbledon Common, Herne Hill (Smallman), Dulwich (Helps), near Balham (Frohawk), Guildford (Grover), Woking (S. G. C. Russell), Horsley (Turner), Kenley (Carrington), between Witley and Farnham (Oldfield), Dorking, common everywhere (Oldaker), Oxshott (Bird), Sutton (Carpenter), Virginia Water (Raynor), Shere (Tremayne). SUSSEX: common, and generally distributed (Goss), west Sussex, common (Fletcher), Abbott's Wood (Dale), Eastbourne (Sotheby), Balcombe (Hamlin), Hastings, Pett, Shipley, Cowfold, Storrington (Bird), near Beachy Head (Sich), Burgess Hill (Dollman), Hailsham (Carr), Bognor (Oldaker), Alfriston (Smallman), St. Leonard's (Bloomfield), Forest Row (Turner). TYRONE: Favour Royal (Kane), common, in suitable localities (Greer). WATERFORD: Roanmore (Wood). WARWICK: common everywhere (Wainwright), Birmingham district (Bath), Rugby district (Napier). WESTMEATH: Mullingar (Middleton). WESTMORLAND: Witherslack (Arkle), Kendal district (Moss). WICKLOW: Glendalough (Pearson). WILTS: Calne (Eddrup), Savernake Forest (Kimber), Salisbury (Carr). WIGTOWN: throughout (Dalglish), Wigtown (Gordon), Monreith (Morton). WORCESTER: common (Fletcher). YORKS: common throughout (Porritt), very sparingly near Rotherham in hot dry summers (Brooks), Cleveland district—Ayton, Eston, Middlesborough (Lofthouse), Doncaster (Clark), near Newby (Leighton), near Scarborough, scarce (Tetley), Thirsk, Sandburn Wood (Walker), Sheffield, rare (Hall), Hull district (Boult).

DISTRIBUTION.—Throughout the greater part of the Palæarctic and Nearctic regions, extending in Africa as far south as Abyssinia, and in Asia through north India, Thibet, and part of China. It extends to an extremely high latitude far within the Arctic area. AFRICA: the countries touching the Mediterranean sea-board (? excluding Egypt), as far back as the Atlas Mountains, at 5500ft. (Meade-Waldo), the Canary Isles, Madeira (Mathew and J. J. Walker), Abyssinia (Lucas). AMERICA: Atlantic States (Dyar), extending across the United States to the Pacific coast, California, Canada (Scudder), Labrador (Moore), up to Moose Factory, James' Bay (Weir), and as far as lat. 81° 45′, at Discovery Bay, in Grinnell Land (Feilden *teste* McLachlan). ASIA: throughout, except middle and southern India, and the southeastern portion of the continent, Corea—Gensan, Chemulpo (Leech), Wei-hai-Wei (Fletcher); China—Chusan Isles (J. J. Walker), Chifu (T. B. Fletcher), Snowy Valley, Ningpo, Kiukiang (Leech); Japan—Hakodaté (T. B. Fletcher), Kiushiu, Nagasaki (Leech), Wadatoge, Kisogawa, Kobé, Nikko (Brit. Mus. Coll.), Yokohama, Boshiu, Kadzusa, Kanosan (Pryer); Amurland — Pärchen-by-Chab (Graeser), Sutschan district (Dorries), Pokrofka, Permskoe Mülki (Graeser), the Ussuri (Maack), Kamschatka (Herz); Thibet — Lhasa, Gyangtse (Walton); India — western Himalayas — Mussoorie, up to 8000ft. (McKinnon and Nicéville), Himalayas — Thundiani,

Dalhousie (Brit. Mus. Coll.), Mandi (Young), Simla (Sharpe), Pangi (Elwes), Huttos, 10000ft., Goorais Valley, Kokser (Leech Coll.), Dugi, 12000ft. (Thompson), Rala, etc. (McArthur), Kurrachee, Katti (Brit. Mus. Coll.), Chitral—Drosh (Leslie), Shishi-Kuh Valley (Colomb), Hunza (Conway), Ladakh (Adair); the Altai Mountains (Biisk, in Brit. Mus. Coll.); Turkestan—Samarcand (Fedchenko); Bokhara—Kabadian, the Pamirs, to 4000ft., Kounjout Mountains, Col Beïk, at 14000ft. (Grum-Grshimailo); Turcomania—Achal Tekke district—Göktepe, Germob, Krasnowodsk, Daghescan, Kasumkent (Christoph); Afghanistan—Candahar (Brit. Mus. Coll.); Persia—north Persia, Gjas, Astrabad, Lenkoran (Christoph), Teheran (Jourdain), Irak (Young), Osch (Grum-Grshimailo); Transcaucasia, everywhere—Derbent, Ordoubad, Lenkoran, etc. (Romanoff); Armenia—Alexandropol (Christoph); Syria—Palestine, Jerusalem (Swinton), Galilee (Pratt), near Jaffa, Dumar, Zebedani, Baalbek, Jebel Barouk, Beyrout, Ain Zahalta, Damascus, etc. (Graves), the Lebanon and Antilebanon—Brummana (Nicholl); Asia Minor—Broussa (Fountaine), Cilicia (Holtz), Lemnos, Smyrna, Beyrout, Marmarice, Besika Bay, Artaki, Tchanak, Corfu, Crete, Canea, Suda Bay, Cyprus (Mathew), Rhodes (Loew). Europe—Austria: everywhere common (Höfner), Bohemia—Prague (Nickerl), Karlsbad (Hüttner), Budweiss, Senftenberg (Fritsch); Moravia—Brünn (Schneider), Iglau, Kremsier, Neutitschein, Rottalowitz, Troppau (Fritsch); Upper Austria—Freistadt, Linz; Lower Austria—Gresten, Vienna (Fritsch), Hernstein district (Rogenhofer); Salzburg, nowhere frequent, mostly singly (Richter); Salzburg—Tyrol, from the valleys to 6000ft. (Hinterwaldner), Mendel, Cortina, etc. (Tutt), Glockner district, Bozen, Trient (Mann), near Innsbruck, from 1850ft. to 6000ft., Taufers Valley (Weiler), the Brenner (Rowland-Brown), Bregenz, Trotzberg (Fritsch); Wolfsberg (Lemann), Carinthia—near Raibl (Zeller); Hausdorf, St. Jakob, Oberhaag; Styria—Admont, etc. (Fritsch); Carniola—Upper Carniola, very common, Dalmatia (Mann); Hungary, abundant throughout (Fountaine), Herculesbad (Lang). Belgium: common throughout—particularly abundant near Namur (Lambillion), Frameries, near Mons (Dufrane), Dinant (Lenoir), Rochefort (Carlier), etc. Bosnia and Hercegovina: throughout—up to 1600m.—Dervent (Hilf), Visoko (Simonys), Ljubiĕna (Sturany), Treskavica (Apfelbeck), Bjelasnica (Rebel, to 1600m.), Maklenpass (Hilf), Nevesinje (Uhl), Blagaj (Nicholl), Trebinje, Bilek, Vucija Bara (Rebel), Volujak (Apfelbeck). Bulgaria and East Roumelia: throughout, up to 1500m. in the Rilo—Sophia, Samakow, Kostenec, Rasgrad, Rustschuk, Slivno, Schipka (Rebel), Ister, in the Rilska Valley, the Rilo Dagh, to 4000ft. (Nicholl), Burgas (Apfelbeck). Channel Islands: Guernsey, Alderney, common, Herm, Sark (Luff), Jersey (Piquet). Corsica: throughout — Vizzavona (Rowland-Brown), Corte, Tattone, Ajaccio (Rosa), etc. Denmark: throughout (Bang-Haas). Finland: south and southeast (Lampa). France: throughout (Berce), Allier (Peyerimhoff), Alpes-Maritimes—Nice, Beaulieu (Rowland-Brown), Villefranche (Mathew), St. Martin Vésubie (Lang), Var—Hyères, Costebelle, Cannes, Pegomas, Auribeau, Agay (Tutt), La Bocca, Grasse (Chapman), Aisne—St. Quentin, etc. (Dubus), Aube (Jourdheuille), Aude (Mabille), Brittany, throughout (Griffith), Ariège—l'Hospitalet, Ax, etc. (Rowland-Brown), Basses-Alpes—generally, Digne, Beauvézer, Colmars, Allos, etc. (Tutt), Basses-Pyrénées—Biarritz (Rowland-Brown), St. Jean de Luz, Guéthary, etc. (Chapman), Bouches-du-Rhone—Marseilles (Walker), Arles, Aix, etc. (Rowland-Brown), Calvados (Montiers), Côtes-du-Nord—Val André (Turner), Cher, Creuse, Cantal (Sand), Doubs (Bruand), Dordogne (Tarel), Eure (Dupont), Eure-et-Loir (Guenée), Gard—Remoulins, Pont du Gard, Nîmes, Aigues-Mortes, etc. (Rowland-Brown), Gironde (Brown), Hautes-Alpes—Abriès, Larche, etc. (Tutt), Hautes-Pyrénées, to 5000ft. (Elwes), Gédre, etc. (Rondou), Haute-Garonne (Caradja), Haute-Savoie—Annecy, Chavoire, Chamonix, etc. (Tutt), Ille-et-Vilaine—Rennes (Oberthür), Indre—Nohaut, etc. (Sand), Indre-et-Loire—Tours (Meade-Waldo), Loire-Inférieure—Nantes (D-Roy), Lozère—Florac, Mende, Maine—Rheims, etc. (Rowland-Brown), Manche—Cherbourg (Nichollet), Maine-et-Loire—St. Christophe-du-Bois (Delahaye), Nord (Paux), Puy-de-Dôme (Sand), Pas de Calais—near Hesdiu (Rowland-Brown), Pyrénées-Orientales—Vernet-les-Bains (Nicholson), Saône-et-Loire (Constant), Savoie—St. Michel de Maurienne, Grésy-sur-Aix, Chambèry, Bourg St. Maurice, Little St. Bernard, etc. (Tutt), Seine—Paris district, Courbevoie, Parc Maison Lafitte (Walker), La Varenne, St. Maur (Ragonot), Seine-et-Marne—Fontainebleau (Tutt), Seine-Inférieure—Tancarville (Leech), Somme—near Créçy, Vaucluse—Avignon (Rowland-Brown). Germany: Prussia—Memel, Tilsit, Königsberg, Insterburg, Rasteuberg, Thorn, Graudenz, Marienwerder, Elbing, Danzig, etc. (Speiser); Pomerania—Stettin (Hering), Greifswald, Stralsund (Paul and Plötz); Mecklenburg—Neustrelitz, Friedland, Sülze, Rostock, Wismar, Schwerin,

Parchim, etc. (Gillmer); Lübeck, Lauenburg, Schleswig-Holstein, Hamburg, everywhere common—Lübeck (Tessmann), Eutin (Dahl), Ratzeburg, Mölln, Lauenburg (Gillmer), Hamburg (Laplace), Kiel, Schleswig, Flensburg (Gillmer); Hanover, Brunswick, and Oldenburg, everywhere common—Lüneburg (Machleidt and Steinvorth), Celle, Hanover (Glitz), Brunswick, Wolfenbüttel, Helmstedt (von Heinemann), Harz, Göttingen (Jordan), Hameln, Bremen (Rehberg), Oldenburg, Aurich, Osnabrück, etc.; Westphalia, Lippe, Waldeck, everywhere common—Minden, Münster, Paderborn, Höxter, Iserlohn, Dortmund, Detmold, Rhoden, Arolsen, Korbach (Speyer); Rhine Provinces—Duisburg, Elberfeld, Cologne, Bonn, Aix, Coblenz, Trier, etc. (Stollwerck); Hesse-Nassau—Wiesbaden (Rössler), Frankfurt-on-Main (Koch), Hanau (Limpert and Röttelberg), Rheingau (Fuchs), Wied-Selters (Schenck), Giessen (Dickore), Biedenkopf, Grünberg, Friedberg (Glaser), Gelnhausen, Rotenburg (Jordan), Cassel (Borgmann); Thuringia—Eisenach, Gotha, Meiningen, Hildburghausen, Coburg, Ilmenau, Rudolstadt, Weimar, Altenburg, etc.; Province of Saxony—Mühlhausen, Nordhausen (Jordan), Erfurt (Keferstein and Werneburg), Naumburg, Halle (Stange), Zeitz (Wilde), Torgau, Wittenberg, Magdeburg, Halberstadt, Quedlinburg (Reinecke), Neuhaldensleben, Stendal, etc., Anhalt — Bernburg, Cöthen, Dessau, Zerbst (Gillmer); Brandenburg — Berlin (Pfützner), Niederneundorf (Dadd), Kottbus, Guben, Frankfurt-on-Oder (Kretschmer), Landsberg, Küstrin, Prenzlau, Wittstock, Ruppin, Perleberg, etc.; Posen—Bromberg, Meseritz, Lissa, etc.; Silesia—Glogau, Liegnitz, Görlitz (Möschler), Breslau, Oppeln, Ratibor, etc.; Kingdom of Saxony—Dresden (Steinert), Chemnitz (Pabst), Leipzig (Verein Fauna Leipzig); Bavaria—Würzburg, Nürnberg, Regensburg (Hofmann and Herrich-Schäffer), Augsburg (Freyer), Münich (Kranz), Kempten (von Kolb); Würtemberg—Stuttgart (Keller and Hofmann), Heilbronn, Reutlingen; Baden — Heidelberg, Karlsruhe, Freiburg (Meess and Spuler), the Palatinate (Bertram); Hesse-Darmstadt (Glaser); Alsace—St. Jean de Croix, etc. (Peyerimhoff); Heligoland (Gätke). Greece: Athens, Phalerum, Salamis Bay, Platen, Poros (Mathew), Attica, Parnassus, Naxos (Merlin Coll.), Morea (Elwes), Corfu (Fletcher), Navarino (J. J. Walker). Italy: Riviera—Albenga (Tutt), Ancona, Brindisi, Florence, Leghorn, Pisa (Mathew), Piedmont—Pré St. Didier, Little St. Bernard Pass, Susa, Torre Pellice, Bobbie, Crissolo, Aosta, Chatillon, Locarno, Stresa (Tutt), Bellagio (F. Walker), Menaggio (Sich), Como (White), Gardone (Jones), Orta Novarese, Certosa di Pesio (Lowe), Baths of Lucca (F. Walker), Palermo, Leghorn, Naples—Vesuvius (Walker), Capri (Browne), Camaldoli, near Naples (Schiemenz), Sicily—throughout (Zeller), Taormina (Walker), Messina, Etna, Syracuse, Catania (Zeller), Tuscany, throughout (Stefanelli), Florence, Viareggio, near Lucca (Verity), Apennines — Boscolungo, etc. (Norris), Rome (White), Turin (Swinton), Tivoli, near Rome (Rowland-Brown). Malta: abundant throughout (Fletcher). Netherlands: everywhere (Snellen). Portugal: Lisbon (Mathew), Cintra, São Barnabe, São Bartholomeu do Messines (Eaton). Russia: through Russia in Europe (Erschoff)—St. Petersburg (Fedchenko), Volga district—Casan, Saratov, rare in south Ural district (Eversmann), Astrakhan, Simbirsk, Samosk, Kuzzan, Orenberg, Ophemski, Archangel, Olonetz, Ekateristz Stavrapol, Tavrachisk (Erschoff and Feild), Baltic Provinces, common (Nolcken), Kurtenhof (Teich), Wiatka dist. (Kroulikowsky), Novorosiisk (Lachte), Podolia (Elwes Coll.). Scandinavia: Norway, south and centre, not uncommon—Christiania, Laurvig, Grue, Laurgaard—Gudbrandsdal, Hamar, Odalen, Naes Vaerk, Arendal, Strandebarm, Bergen, not rare—parts of Alten, Finmark (Siebke), over the whole Arctic region—Porsanger, common, Tromsdal, Målselvdal (Schneider), Saltdalen, Karasjok, Sydvaranger (Schöyen), Malnæs in Vesterålen, Grötö in Vestfjorden (*teste* Schneider), Hammerfest (Staudinger), Bossekop (Chapman); from Skåne to North Finmark (Wallengren), Suldal, etc. (Strand), Saeterstoen, Flodmark (Morton), Roldal (Walker), Ormeim, Romsdal (Jordan), Tveta (Elwes Coll.), Bydal—Jemtland (Rowland-Brown). Spain: Ferrol, Vigo, Gibraltar (Mathew), Algeçiras, San Roque, Ronda (Nicholson), Catalonia—Mont Sény (Witty), Andorra (Rowland-Brown), Andalusia, very common (Rambur), Jerez de la Frontera (Lang), Castile (Leech Coll.), Granada, Balearic Isles—Minorca, Mahon (J. J. Walker), Majorca (Leech Coll.), Pera (Zeller Coll.), Moncayo, Bronchales, Avila, Puerto de Pajares, Albarracin—Cuenca, Tragacete, Bejar (Chapman). Switzerland: widely distributed, but not generally common, except south of the Alps, singly up to 4000ft. or more—Brigue, common, Bérisal, common, Chiasso, common, Veytaux, Arzier, Veyrier, Martigny, Onex, Disentis, Davos, Fusio (Wheeler), Aigle (Tasker), Sion, Sierre, Niouc, Visp, Stalden (Favre), Villars (Moss), Lucerne district (Sanford), Basle, Saas Thal, Visp Thal (Tutt), Bellinzona, Roveredò (Wheeler), Locarno (Tutt), Lugano (Chapman), Trient (Keynes), La

Bâtiaz, Stalden to Hüteck (Tutt), Zürich district (Elwes), Brunnen (Jones), Le Prese, on the Italian side of the Bernina Pass, 3000ft. elevation (F. B. White), Amsteg (Lang), Neuchâtel (Rowland-Brown). TURKEY: Constantinople, Gallipoli, Salonika (Mathew), Port Baklar, etc. (J. J. Walker).

[VARIATION (*continued from p.* 380).—Schultz notes the two following minor aberrations of *Rumicia phlaeas* (*Ent. Zeit. Guben*, xviii., p. 134):—

1. ab. *auronitens*, Schultz, "Ent. Zeit. Guben," xviii., p. 134 (1905).—Alis posticis supra in basali et media area aureomicantibus. In this form the broad, dark area of the hindwings is shot with a red-golden glow at the base and in the central area up to the light hind-marginal band, the glow being absent in typical specimens.

2. ab. *cuneifera*, *Schultz, "Ent. Zeits. Guben," xviii., p. 134 (1905).—Alis anticis subtus striatis = forma elongata, Schultz. The form with enlarged spots occurs in the darker tailed autumn brood; two specimens in which the spots of the central row on the underside of the forewings have a partial stripe-like and partial wedge-like form (♂ from Dusseldorf, ♀ from Corsica).]

## Genus: CHRYSOPHANUS, Hübner.

SYNONYMY.—Genus: **Chrysophanus,** Hb., "Verz.," p. 72 (1816-1818); Stphs., "Illus.," etc., iv., app. p. 404 (1835); Humph. and Westd., "Brit. Butts.," p. 95, pl. xxix., figs. 1-6 (1841); Stphs., "List," p. 18 (1850); Morr., "Hist. Brit. Butts.," p. 127, pl. liv., figs. 1-5 (1853); Sta., "Man.," i., p. 55 (1857); Scudd., "Gen. Rev.," p. 141 (1875); Dale, "Brit. Butts.," p. 45 (1889); Scudd., "Butts. New Engl.," ii., p. 972 (1892); Barr., "Lep. Brit. Isles," i., p. 56, pl. ix., figs. 1-1*b* (1893); Leech, "Butts. China," ii., p. 397, pl. xxviii., figs. 4-6 (1893-4); Meyr., "Handbook," etc., p. 346 (1895); Tutt, "Brit. Butts.," p. 149, pl. i., fig. 10 (1896); "Ent. Rec.," viii., p. 57 (1896); Staud. and Reb., "Cat.," 3rd ed., p. 73 (1901); Wheeler, "Butts. Switz.," p. 13 (1903); Gillm., "Ins. Börse," xxiii., p. 43 (1906); South, "Butts. Br. Isles," p. 148, pl. xcviii., figs. 1-5 (1906). [**Papilio-Plebeius-**] **Ruralis,** Esp., "Eur. Schmett.," i., p. 342 (1779); pl. xxxviii., figs. 1-2 (1777); Haw., "Lep. Brit.," p. 40 (1803). **Papilio,** Lewin, "Ins. Great. Brit.," p. 84, pl. xl., figs. 1-3 (1795); Don., "Brit. Ins.," p. 4, pl. ccxvii (1798); Hb., "Schmett. Eur.," p. 54 (1805); pl. lxx., figs. 352-4 (1799); pl. cxcv., figs. 966-8 (1833); Ochs., "Die Schmett.," i., pt. 2, p. 77 (1808). **Lycaena,** Leach, "Edin. Encycl.," ix., pt. 1, p. 129 (1815); Sam., "Ent. Usef. Comp.," p. 241 (1819); Curt., "Brit. Ent.," fo. 12, figs. 1-3 (1824); Stphs., "Illus. Brit. Ent.," i., p. 81 (1828); Stphs., "List," etc., pt. 2, p. 22 (1829); "Nomen. Brit. Ins.," p. 38 (1829); Dale. "Loudon's Mag.," vii., p. 60 (1834); Freyer, "Neu. Beitr.," ii., p. 55, pl. 127, figs. 1-2 (1836); Wood, "Ind. Entom.," p. 7, pl. iii., figs. 59*a-b* (1839); Kirby, "Eur. Butts. and Moths," p. 55 (1879); "Handbook," etc., ii., p. 117, pl. l., figs. 1-3 (1896). **Polyommatus,** Godt., "Hist. Nat.," i., p. 200, pl. 9 sec., 5, pl. 10 sec., 3 (1821); Bdv., "Icones," i., p. 44, pl. x., figs. 1-3 (1832); Dup., "Hist. Nat.," supp. i., p. 81, pl. xiii., figs. 3-6 (1832); "Cat. Méth.," p. 30 (1844); Staud., "Cat.," 2nd ed., p. 8 (1871); Newm., "Brit. Butts.," p. 114, fig. 37 (1874); Lang, "Butts. Eur.," p. 90, pl. xix., fig. 4 (1881); Kane, "Eur. Butts.," p. 28 (1885); Leech, "Proc. Zool. Soc. Lond.," p. 414, pl. xxv., fig. 3 (1887); Graes., "Berl. Ent. Zeits.," p. 75 (1888); Alph., "Rom. Mém.," v., p. 103 (1889); Horm., "Soc. Ent.," viii., p. 130 (1893); Caradja, "Iris," viii., p. 35 (1895); Rühl, "Pal. Gross-Schmett.," i., pp. 209, 744 (1895); Obth., "Etudes," etc., xx., p. 8 (1896).

The genus *Chrysophanus* was created by Hübner for the whole of the Palæarctic "coppers," and was diagnosed (*Verzeichniss*, p. 72) as follows:—

The wings above shining golden-red, beneath marked with black spots and yellowish-red patch (band)—*Chrysophanus phlaeas*, Linn., *C. timeus*, Cram., *C. helle*, Schiff. (*amphidamas*, Esp.), *C. thersamon*, Esp. (*xanthe*, Hb.), *C. gordius*, Sulz., *C. hyllus*, Cram. (*hylla*, Fab.), *C. hipponoë*, Esp. (*lampetie*, Schiff.), *C. chryseis*, Schiff., *C. eurybia*, Ochs. (*euridice*, Hb.), *C. virgaureae*, Linn., *C. hippothoë*, Linn., *C. circe*, Schiff.

The genus, as described above, was hopelessly heterotypical, but it

* Evidently not so specialised a streaked form as our ab. *infra-extensa* (*anteà* p. 379).

was restricted in 1841, by Westwood, to *phlaeas*, *hippothoe*, *dispar*, and *virgaureae*. The type was fixed in 1875 by Scudder, in his *Generic Revision*, etc., p. 141, as *hippothoë*, Linné, and confirmed by the same author (*Butterflies of New England*, ii., p. 972), where he describes, in detail, the genus *Chrysophanus*, as follows:—

Imago.—Head moderately large, densely clothed with scales and rather abundantly supplied with long, curving hairs of equal length in all parts. Front even, not swollen in any part, except in the least possible degree in the middle below, where it barely surpasses the front of the eyes; half as high again as broad, and of the width of the eye on a front view; upper border marked by the faintest possible transverse ridge, its angles rather deeply hollowed in front of the antennæ; lower border rather strongly, not broadly, rounded. Vertex slightly elevated in the middle and at either side, to form low buttresses behind the antennæ; separated from the occiput by a broad, rather deep, slightly curving sulcation, having a slight pit in the middle, which affects the height of the occiput just behind. Eyes not very large, moderately full, naked. Antennæ inserted with the posterior border in the middle of the summit, separated by a space equal to the width of the basal joint of the antennæ; nearly, or quite, half as long again as the abdomen, composed of thirty-three joints, of which thirteen form the depressed cylindrical club, which is two and a half times broader than the stalk, five times longer than broad, increases very gradually in size at the base, is equal for most of its length, and bluntly pointed at the extremity, three or four joints entering into the diminution of size. Palpi slender, fully half as long again as the eye, the middle joint tapering only on the apical third, the terminal joint more than half as long as the penultimate, and clothed with recumbent scales only, while the others are densely scaled, especially below, and furnished with a heavy fringe of very long, projecting, hairs. Patagia very long and slender, somewhat arched, and slightly tumid, nearly, or quite, four times as long as broad, tapering on the basal half, the apical half about one-third the width of the base, equal or very slightly enlarging, nearly straight, the tip broadly rounded; upper border not excavated. Forewing two-thirds as long again as broad, the costal margin slightly and equally curved at base and tip, the middle two-thirds nearly straight; outer margin very broadly and uniformly rounded, having such a general direction as to form an angle of about 65° with the costal margin, the angle rounded off; inner border scarcely concave on the basal two-thirds, the angle well-rounded. Costal vein terminating some distance before the tip of the cell, subcostal with three branches, first arising a little (♂), or somewhat (♀), beyond the middle of the upper border of the cell; second about two-thirds (♂), or nearly three-fifths (♀), the distance from the origin of the first branch to the tip of the cell; third at the apex of the cell, its forks originating midway (♂), or a little less than midway (♀), from the tip of the cell to the apex of the wing; cross veins transverse, obsolete except next the main veins; cell rather less than half the length of the wing, and three-and-half times as long as broad. Hindwings with the costal margin broadly and roundly expanded next the base, beyond nearly straight, near the apex sloping off towards the outer margin, sooner and more abruptly in the ♂ than in the ♀. Outer margin rather broadly and regularly rounded, fuller, especially on the upper half, in the ♀ than in the ♂; inner border abruptly and considerably expanded at the base, beyond straight or scarcely convex, scarcely emarginate for a short space next the tip, the angle rounded off. Submedian nervure terminating at the anal angle; internal nervure terminating considerably beyond the middle of the inner margin. Fore tibiæ less than three-fourths (♂), or about five-sixths (♀), the length of the hind tibiæ, the spurs naked; the tarsi either nearly equalling the tibiæ (♀), or from three-quarters to four-fifths their length (♂); terminal joint of fore tarsi either like that of the other legs (♀); or small and tapering, feebly divided by faint impressed lines into simulations of joints, the tip armed with only a single apical hook, differing from the spines which crowd up to it only in being longer and a little more curved; furnished above with short dense hairs, instead of scales (♂). All the femora provided with a fringe of rather close long hairs on the undersurface. Middle tibiæ either as long as (♀) or a little shorter than (♂) the hind tibiæ, rather abundantly armed beneath, and to a slight extent on the sides, with not very long but slender spines, and at the apex with a pair of moderately short and slender spurs scaled nearly to the tip. First joint of tarsi fully equalling the others together, the next three diminishing in regular ratio, the fifth equal to the second; the joints furnished very abundantly beneath, with very long and rather slender spines, excepting on the basal joint, mostly collected upon the sides, and in a naked field; an apical pair on each joint longer

than the others; claws small, not stout, compressed, tapering, considerably and regularly, but not very strongly, curved; paronychia double, each lobe fully as long as the claw, equal, very slender, the superior straight, the inferior curving strongly inward and forward; pulvillus inconspicuous. Genital organs.—Lateral alations of upper organ of male abdominal appendages pretty large, bent strongly downward in the middle, divergent, leaving an U-shaped opening between their bases; lateral arms very long and slender, acicular, strongly bowed. Clasps very uniform in size from base to tip.

Egg.—Slightly more rounded above than below, the base being rather broadly truncate; cells small, those in the middle of the egg disposed with some regularity in diagonal rows, the walls of irregular height being much elevated into rounded bosses at the lines of juncture. Micropyle rosette occupying the whole floor of a pretty deep infundibuliform cavity, the sides of which are abrupt. [See *posteà* pp. 439 *et seq.*]

Caterpillar at birth.—The only specimens I have seen being dead, and dried bodies extracted from eggs which did not hatch, I can only say that the caterpillars of this genus when they first emerge resemble those of *Heodes* in almost every particular, but that the secondary warts of the infrastigmatal row are apparently absent. (See *posteà* pp. 443 *et seq.*]

Chrysalis.—Considerably more than twice as long as broad, the sides of the body straight, and parallel from one extremity of the wing to the other; behind the wings the abdomen, as viewed from above, is elliptical, well rounded; in front of the wings the body tapers rapidly, and has an appressed rounded front, the basal wing-prominences being marked only by the angle the front part of the body makes with the wings. Viewed from the side, the flat bottom has the anterior fourth raised at a slight angle; the thorax is highest, and nearly equal, on the posterior third, in front of it very broadly arched, sloping about equally downward and forward. Abdomen very broadly arched above, highest and very slightly higher than the thorax at the 3rd and 4th segments, the last four segments curving rapidly downward, the posterior point being at the summit of the 9th segment, below which it curves forward slightly; the downward curve at the posterior is much more rapid than at the anterior end of the body. Transversely, the middle of the thorax has a parabolic curve, well rounded above; the abdomen is well arched, regularly rounded, considerably higher than a semicircle. More than three-fifths of the tongue is exposed. Basal wing-prominence consisting of a broad, low, rounded, slight elevation, which would be scarcely noticeable but for the narrowing of the anterior part of the body. Body covered equally with a very delicate tracery of lines, equally raised everywhere, excepting at the points of intersection, where there are minute warts; they cross each other irregularly, forming angular, moderately large, cells; within the cells is frequently seated a large wart, giving rise to a fungiform bristle, the basal three-fourths of the pedicel equal, moderately stout, the apical fourth rapidly expanding to a shallow, greatly expanded, infundibuliform disc, the horizontal edges of which are fringed with fleshy ciliate lobes. Hooklets of cremaster rather long and slender, the stem equal, straight on basal, curved a little on apical, half, the expanded portion transverse, three or four times broader than the stem, curved strongly, over the apical margin nearly straight, the sides strongly produced laterally, and somewhat backward. [See *posteà* pp. 450 *et seq.*]

There appear to be only three Palæarctic species belonging to the genus, *viz.*, *Chrysophanus dispar*, Haw., *splendens*, Staud., and *hippothoë*, Linn., but these are among the most beautiful insects in the Palæarctic fauna. The species *lampon*, Ld., *thersamon*, Esp., *omphale*, Klug., *satraps*, Zell., and *asabinus*, H.-Sch., form another closely-allied little generic group. Scudder says that there "seems to be only a single species (*Chrysophanus thoe*) in America, confined to the eastern side of the continent." "The group," he says, "comprises some of the larger *Chrysophanidi*. The wings of the sexes differ in colouring, though, at least in the American species, but little in form," etc. The sexual difference is very marked in the Palæarctic species, the ♂ being uniformly bright golden-red or copper, with black outer margin and discoidal lunule, the ♀ of the same tint, but with parallel rows of black spots, as in the allied genera (*Rumicia*, *Loweia*, etc.), the hind-wings also with a row of black spots, the undersides, especially of the

hindwings, being spotted very similarly to those of the blue butterflies. The ♀ is more square-winged than the ♂. Scudder says that "the American" species is double-brooded, and probably winters in the egg-stage. The two commoner Palæarctic species, *Chrysophanus hippothoë* and *C. dispar*, hybernate in the larval stages. Both species are usually single-brooded in central and northern Europe, although, occasionally, partial double-broods occur in the warmer parts of their distribution.

In our account of the tribe, we omitted (*anteà*, p. 326) our notes of the gynandromorphism recorded within its limits. These we now add. They are as follows:

Heodes virgaureæ, L.—α. Complete gynandromorph. Right hand side ♂, left ♀. Captured near Magdeburg, in 1893 (Rühl, *Pal. Gross-Schmett.*, p. 741).

β. Halved. Right hand side ♂, 16mm.; left ♀, 14mm. Captured near Berlin (Wiskott, *Lep.-Zwitter*, etc., p. 10).

γ. Right side ♂, left side ♀; offered by Ribbe in his sale Catalogue, no. 14 (Schultz, *Berl. Ent. Zeits.*, xlix., p. 79).

Chrysophanus hippothoë var. eurybia, Ochs.—Incomplete. Left wings, also right forewing, ♀; right hindwing, by colour and marking, with preponderance of ♂ characters. Underside ♀. Form of abdomen ♀. Captured by Wiskott at Saas Fee (Wiskott, *Lep.-Zwitter*, etc., p. 11).

Loweia alciphron, Linn.—Complete gynandromorph, distinctly divided. Left side ♂, right side ♀. Caught by Treue, near Strassberg, in 1895. In the "Thiele Coll.," Berlin (Schultz, *Illus. Woch. für Ent.*, ii., p. 364).

Loweia amphidamas, Esp.—α. Left side ♂, right side ♀. Ordinary size, without partition line on body, and no difference of the antennæ. The difference in the wings on the two sides most pronounced, the ♂ side with the normal blue gloss, the ♀ side entirely without. The forewing of the right side hardly perceptibly longer than the left. Underside without marked difference. In Berlin Museum Coll. (Klug, *Jahrb.*, 1834, p. 256).

β. Right side ♂, left side ♀. Extracted from pupa found near Leipzig, 1893 (Rühl, *Pal. Gross-Schmett.*, p. 220).

γ. Equally divided. Right side completely ♂, left completely ♀. Recorded (*in litt.*) by Lorez of Zürich (Schultz, *Illus. Woch. für Ent.*, i., p. 321).

δ. Completely halved. Right side, wings and antenna, ♂; left side, ♀. Body inclining to ♀ in form. Genitalia with traces of both sexes. Captured 1896. In coll. Hartmann, of Rerchenbach (Schultz, *Illus. Woch. für Ent.*, ii., p. 364).

ε. Left side ♀, 12mm.; right side ♂, 11mm. The ♂ side conspicuous by its blue tint. No difference in antennæ. Body ♀ in form. Reared in Saxony. In Wiskott coll. (Wiskott, *Lep.-Zwitter*, etc., p. 11).

ζ-η. Two complete gynandromorphs. (ζ) With the left side ♂, the right side ♀. (η) With the right side ♂, the left side ♀. In both specimens the difference of sex is conspicuously distinct in the wings, the ♂ side, in both cases, having the red colour very restricted, and the blue gloss spread over the wing, whilst the ♀ side has the red very much more developed, and there is no trace of the blue gloss. The ♂ side has the wings shorter and narrower than those of the ♀ side. Both probably from near Leipzig. In the "Hoffmann coll.," Cologne (Schultz, *Illus. Zeits. für Ent.*, iii., p. 102).

ι. Gynandromorph. Left wings ♀ (of the typical form reared from winter pupæ), right wings ♂. Wing expanse 25mm., the ♀ forewing a trifle larger than the ♂ forewing. The abdomen is fuller and stouter on the left, than on the right, side. The end of the 9th abdominal segment on the right side, with a distinct lower flap; the end of the 8th abdominal segment on the left side, with longer grey-black hairs, conspicuously indicating it as the last segment on that side, so that the body appears as if cut off unevenly. Reared by Standfuss, at Zürich, February 20th, 1898, from a pupa received from Leipzig (Schultz, *Illus. Zeits. für Entom.*, iii., p. 102).

κ Gynandromorph. Mentioned without description (*Ent. Zeits. Guben*, xi., p. 186).

## Chrysophanus dispar, Haworth.

Synonymy.—Species: **Dispar,** Haw., "Lep. Brit.," p. 40 (1803); Leach, "Edin. Encycl.," ix., pt. 1, p. 129 (1815); Sam., "Ent. Comp.," p. 241 (1819);

Curt., "Brit. Ent.," fo. xii.. figs. 1-3 (1824); Stphs., "Illus. Haust.," i., p. 81 (1828); Dup., "Hist. Nat.," supp. i., pl. xiii., figs. 3-6 (1832); Bdv., "Icones," i., p. 44, pl. x., figs. 1-3 (1832); Dale, "Loudon's Mag.," vii., p. 60 (1834); Wood, "Ind. Entom.," p. 7, pl. iii., figs. 59*a*-*b* (1839); Humph. and Westd., "Brit. Butts.," p. 95, pl. xxix., figs. 1-6 (1841); Dup., "Cat. Méth.," p. 30 (1844); Morr., "Hist. Brit. Butts.." p. 127, pl. liv., figs. 1-5 (1853); Sta., "Man.," i., p. 55 (1857); Staud., "Cat.," 2nd ed., p. 8 (1871); Lang, "Butts. Eur.," p. 9, pl. xx., fig. 1 (1881); Kane, "Eur. Butts.," p. 82 (1885); Graes., "Berl. Ent. Zeits.," p. 75 (1888); Alph., "Rom. Mém.," v., p. 103 (1889); Dale, "Brit. Butts.," p. 45 (1889); Barr., "Lep. Brit. Isles," i., p. 56, pl. ix., figs. 1-1*b* (1893); Leech, "Butts. China," ii., p. 397, pl. xxviii., figs. 4, 6 (1893-4); Dale, "Ent.," p. 60 (1894); Meyr., "Handbook," etc., p. 346 (1895); Rühl, "Pal. Gross. Schmett.," pp. 209, 744 (1895); Carad., "Iris," viii., p. 35 (1895); Tutt, "Brit. Butts.," p. 149, pl. i., fig. 10 (1896); "Ent. Rec.," viii., p. 57 (1896); Obth., "Études," xx., p. 8 (1896); Kirby, "Handbook," etc., ii., p. 117, pl. l., figs. 1-3 (1896); Merrin, "Ent. Rec.," xi., p. 208 (1899); Staud., "Cat.," 3rd ed., p. 73 (1901); Wheel., "Butts. Switz.," p. 13 (1903); Gillmer, "Ins. Börse," xxiii., p. 43 (1906); South, "Butts. Br. Isl.," p. 148, pl. xcviii., figs. 1-5 (1906). **Hippothoë**,* Esp., "Schmett. Eur.," p. 350 (1779); pl. xxxviii., figs. 1*a*-*b* (1777); Fab., "Mant.," pt. 2, p. 79, *in part*, reference to Esper. etc. (1787); Lewin, "Ins. Gr. Brit.," p. 84, pl. xl., figs. 1-3 (1795); Don., "Brit. Ins.," vii., p. 4, pl. 217 (1798); Hb., "Eur. Schmett.," p. 54 (1805), pl. lxx., figs. 352-4 (1799); Hb. and Gey., "Eur. Schmett.," pl. cxcv., figs. 966-8 (1833); Ochs., "Die Schmett.," i., pt. 2, p. 77, ? 83 (1808); God., "Hist. Nat.," i., p. 200, pl. ix sec., 5, pl. x sec., fig. 3 (1821); Freyer, "Neuere Beit.," ii., p. 55, pl. 127, figs. 1-2 (1836); Dup., "Cat. Méth.," p. 30 (1844); [? Evers., "Faun. Volg. Ural.," p. 63 (1844);] Hein., "Schmett. Deutsch.," p. 89 (1859); Newm., "Brit. Butts.," p. 114, fig. 37 (1874). **Rutilus**, Werneb., "Beitr.." i., p. 391 (1864); Horm., "Soc. Ent.," viii., p. 130 (1893); Caradja, "Iris," viii., p. 35 (1895). **Auratus**, Leech, "Proc. Zool. Soc. Lond.," p. 414, pl. xxxv., fig. 3 (1887). (See also *posteà*, pp. 432 *et seq.*]

Original description. — *Papilio Plebeius Ruralis* alis igneo-cupreis puncto margineque nigris, posticis subtus pallide cœruleis punctis numerosis, margineque cupreo. Habitat: Imago f. Jul. in Paludibus arundinetis in comitatu Cantabrigiense ubi, certis at non determinatis annis, frequens. Nova et pulcherrima species ad Angliam; nuper detecta a me et amicissimis meis W. Skrimshire et F. Skrimshire M. D. et olim in Wallia celeberrimo Hudsono Botani-

* In the *Ent. Mo. Mag.*, xxii., p. 64, Mr. Butler considers that the Linnean species should be *C. dispar*, Haw. (*rutilus*, Wernb.). In my *Lepidoptera Scandinavicae Rhopalocera* (1853), I have already said "*P. hippothoë* auct., non in *Suecia*, est repertus, quare synonymiam Linnei citatam, F.S., no. 1046, ad hanc speciem—*P. chryseis.* W.V.—pertinere credo. Descriptio a illustr. viro, l.c., data nullam differentiam præbet:—Statura *P. virgaureae* ut in descriptione Linnei dicitur cum *P. chryseis* etiam magis cum *P. hippothoë* congruit." When I wrote these words, the Scandinavian peninsula had been by no means so fully explored as it now is, and, at that time I thought it not impossible that *C. dispar* might be found. I then did not give *C. chryseis* its Linnean name. During the twenty-two years that have since elapsed, our country has been thoroughly searched, and in no place has *C. dispar* been found. It is, therefore, impossible that such a butterfly can have escaped the observation of the numerous collectors who have since investigated the peninsula. The species that Linneus described in his *Fauna Suecica*, should be one that occurs in Sweden—"Habitat apud nos rarissime" are the words of Linneus. No species other than *C. chryseis* has been found in Sweden to which the Linnean description is applicable. Messrs. Staudinger and Kirby are thus right in giving to *C. chryseis* the name *hippothoë* of Linneus. *C. dispar* does not occur in Denmark nor in Finland, but *C. chryseis* is found in both. In Sweden and Norway *C. chryseis* is nowhere common, but occurs here and there in the southern and middle provinces, and I am sure it is the *P. hippothoë* of Linneus. Dalman, in his *Uppställning af Sveriges Fjärilar* (1816), also says, concerning *P. hippothoë* (=*dispar*):—"anne unquam in Suecia inventa haec species? mihi numquam obvia, quare fere crediderim synon. Linnei forte ad sequentem (=*chryseis*) pertinere (Wallengren, *Ent. Mo. Mag.*, xxii., p. 90).

corum: sed nunquam in Scotia, ut amicus meus E. Donovan ex informatione erronea dixerit. [*Pap. dispar*, "Prod. Lep. Brit.," p. 3. *P. hippothoë* varietas, Esper, "Schmett.," t. 34, f. 1. *P. hippothoë*, Lewin, "Pap.," pl. 40. *P. hippothoë*, Don., "Br. Ins.," pl. 117, nec aliorum auctorum, quæ ultima species optime delineata est in Roes., "Ins.," cl. 2, t. 37, f. 6-7. Mas. Valde affinis *Pap. gordio*, Esperi et Roemeri, at non eadem.] Expansio alarum 2 unc. Descriptio: Mas. Alæ primores supra nitidissime fulvo-cupreæ, puncto disci sublunari sesquialtero, margine postico, apice et ipsa costa nigris. Subtus pallidiores cupreo-fulvæ punctis 10 ocellaribus pupilla majuscula nigra iride alba, tres anticæ subtus costam longitudinaliter positæ, 7 posticæ in striga transversa versus costam parum arcuata; præter has, striga punctorum nigrorum sine iride ad marginem posticum: demum margo albicans. Alæ inferiores subemarginatæ supra nitidissime fulvo cupreæ, puncto oblongo disci, marginibusque nigris; in margine postico maculis 5 subtrigonis nigris introrsum spectantibus: subtus pallide-cœruleæ punctis numerosis nigris subocellaribus, 5 anticis sparsis, pone has lineola nigra, tunc striga postica undata ex punctis 9, omnibus cum lineola, albo cinctis pro iride; tandem fascia cuprea ad marginem posticum (quæ margines haud attingit), singulo latere punctis 8 nigris sine iride; denique margo albida. Femina mari subtus omnino simillima, sed supra valde discrepat, unde nomen; alæ primores supra paulo obscuriores quam in mare, maculis 10 nigris, 3 anteriores subtus costam longitudinaliter positæ, 7 in striga postica arcuatæ; margo posticus magis fuscus quam in mare. Alæ inferiores fuscæ, venis fasciaque postica sexdentata (quæ margines haud attingat) cupreis. In utroque sexu antennæ nigræ albo annulatæ, ciliis alarum omnium albidis utrinque (Haworth).

Imago.—35mm.-50mm. Forewings deep orange-red or orange-copper, with a narrow black hindmarginal border, somewhat extended at apex; antemedian and discal spots black, small in ♂, large in ♀; in the latter an angulated submarginal transverse series of roundish black spots. Hindwings of the same colour as forewings, with black marginal border and slender discal lunule; in ♀ a transverse submarginal series of extended spots running towards discal spot. the median, inner-marginal, and basal areas suffused with fuscous, except along nervures. Forewings beneath orange, with black spots edged with whitish; hindwings greyish, bluish basally; an orange marginal band surmounted with black dots, a subterminal row of dots, discal lunule, and five basal dots, black, edged with white. Fringes of all the wings white.

Sexual dimorphism.—The sexual difference in this species is most marked. The ♂ is entirely of a bright coppery-red colour, with a fine linear discal streak, on all four wings; a smaller black spot, between the discal spot and the base of the forewings, and a narrow, black, marginal border to both fore- and hindwings. The ♀ is of the same fiery tint, but has, in addition to the black discal spot, one and sometimes two black spots between this and the base, larger than in the ♂, also a broader marginal band, and, in addition, a submarginal transverse row of interneural black spots; the nervures, too, are often black, especially towards the outer margin; the hindwings are brownish-black, with coppery-red submarginal band and nervures, and narrow black hindmarginal band;

the discal spot, and an elongated transverse series of interneural black dots, usually standing out clearly in the fuscous-shaded median area. There is considerable difference in the outline of the wings of the two sexes, that of the ♂ being distinctly narrower and more pointed at the apex, that of the ♀ broader and squarer. On the average the ♀ is larger than the ♂.

Historical account of British Chrysophanus dispar.—It is a remarkable fact that the oldest figures and description of our British insect occur in Esper's *Schmett. Eur.*, i., pl. xxxviii., figs. 1-2 (1777), p. 350 (1779). Whilst describing it under the name *hippothoë*, he expresses the gravest doubt of its being specifically identical with *hippothoë*, Linné. "The upperside," he says, "is of a more fiery and glossy colour than *P. virgaureae*, has a much broader outer marginal band; the ♀ has on the upperside very extraordinarily regular spots, whilst, in *hippothoë*, the upperside is darker and brown. The upperside differs still more strikingly from, and has nothing in common with, either *P. virgaureae* or *P. hippothoë*. The wings of the former are, on the underside, of the same yellow tint, the hindwings with single dots and spots bordered with white. How different from the insect figured! The underside of the wings of the latter (*hippothoë*) is dirty yellowish-grey, the eye-spots more numerous, standing in a different position. Compare this with the insect figured! Here the underside is grey, with a vivid tinge of blue, and a broad margin of the same colour; the eye-spots are bordered by a white edge, whilst the bright red marginal band is alone almost enough to distinguish it. . . . . The originals from which the figures are taken are from the collection of Councillor Jung, in Uffenheim (Bavaria). Of its habitat, time of appearance, larva, and natural history, nothing can be learned." It was first noticed as a British species by Lewin, *Insects of Great Britain* (1793), p. 84, pl. xl., figs. 1-3, also under the name *hippothoë*. He states that "some specimens were met with by a gentleman in Huntingdonshire, on a moorish piece of land, and were afterwards sent to Mr. Seymour, of Dorsetshire, who presented them to the late Dowager-Duchess of Portland, and are now in the collection of J. J. Swainson." In 1798, Donovan, in *The Nat. Hist. of British Insects*, vii., p. 4, pl. 217, described and figured the insect, noting that "our *P. hippothoë* is the largest and rarest of the butterflies called 'coppers;' we have heard that this insect has been lately found in Cambridgeshire. Our specimens were met with in Scotland; the ♀ is larger than the ♂, and has a greater number of black spots on the wings." It was not until Haworth published the *Lepidoptera Britannica*, in 1803, that the name *dispar* was applied to our British insect, which was then described as "a new and very beautiful species." This author informs us that "the butterfly, in July, frequents the marshes of Cambridgeshire in certain but undeterminable years," further, that it is a new and very beautiful species, lately detected by himself and his very dear friends, W. Skrimshire and F. Skrimshire, M.D., and formerly in Wales by the celebrated botanist, Hudson. He also adds that the species "has not been taken in Scotland, as Donovan has affirmed from erroneous information." It would appear that the Messrs. Skrimshire first saw this butterfly near Ely, in 1797 or 1798, and that, knowing it was not a common one, they afterwards went with Haworth to capture it. The Aberdeen locality for *dispar* appears to have been

maintained by Samouelle, who, in 1819, gives (*Ent. Usef. Comp.*, p. 241) the names of three copper butterflies as inhabiting Britain, besides the small copper (*Rumicia phlaeas*). These are: (1) "*Lycaena dispar* (the large copper), *Papilio hippothoë* of Donovan. Inhabits the fens of Cambridgeshire, and has been observed near Aberdeen, in Scotland." (2) "*Lycaena chryseis* (purple-edged copper). Inhabits Europe; in Britain it is extremely rare." (3) "*Lycaena virgaureae* (scarce copper). Inhabits Europe; very local in Britain. It is found in some parts of Huntingdonshire." There can be little doubt that *L. dispar* and *L. virgaureae*, as mentioned above, refer to the same species. The maintenance of the Aberdeen locality, first started by Donovan, is quite inexplicable in the face of Haworth's previous remarks. Before leaving Haworth's own published remarks, it may be well to quote a letter of his on the subject to the Rev. W. T. Bree, who communicated it to *Ann. Mag. Natural History*, 1834, vii., p. 522. In this, Haworth remarks: "Some entomologists once made an excursion into the fens for the purpose of taking the beautiful *Lycaena dispar*, or large copper butterfly, which, it is well-known, frequents low marshy grounds. The coppers were captured in good abundance. It so happened that the following winter proved to be a very wet one, and the entire tract of land where the coppers had been found was completely inundated, and actually lay under water for a considerable time. The entomologists deemed that the flood would certainly destroy the coppers, and that the race would become extinct in that part of the country. The next summer, however, the butterflies were found again on the very same spot, as plentifully as before. Subsequently, the tract of land was submitted to the action of fire, and the whole surface burnt, with a view to agricultural improvement. After this operation, the coppers were no longer met with in that particular locality." In 1824, Curtis notices (*Brit. Ent.*, fo. xii) the species, under the name of *dispar* (with references to Haworth, Esper, Lewin and Donovan), and records its capture in Yaxley Meer, whilst, in the 2nd ed. of this work, he states that "This splendid butterfly was first discovered in Wales by the celebrated botanist, Hudson, and Dr. Skrimshire took it many years since on Bardolph Fen, in Norfolk. Of late years, it has appeared in vast abundance at Whittlesea Mere, in Huntingdonshire, and has been found from June 25th to August 10th, and, at the beginning of July, the larva, pupa and imago, have all been found alive on the same day. This butterfly is very active, and in windy weather conceals itself amongst the highest reeds. It frequents, on fine days, the spaces covered with sedges and coarse grass that spring up where reeds have been cut down." Kirby and Spence (1826) make reference to this species, in their *Introduction to Entomology*, in the following sentence:—"Morasses also have their peculiar insects. In this kind of district, in the Isle of Ely, has been taken that scarce and beautiful butterfly *Lycaena virgaureae*, by a Fellow of Trinity College, Cambridge," showing that, even then, the nomenclature, as in use among British lepidopterists, was somewhat mixed. Mr. C. W. Dale asserts that, after the capture of the specimens mentioned as having been taken by Haworth and the Messrs. Skrimshire, the next specimens were taken at Whittlesea Mere, by Thomas Speechly, an old boatman in his father's employ, in July, 1819, and subsequently by his father himself and the Messrs. Standish. He says: "It appears to have occurred in great plenty, as several hundreds were taken within the next ten years by the London

collectors, who visited Whittlesea and Yaxley Meres during the month of July, for the sole purpose of obtaining specimens. In 1827, Mr. Haworth took fifty specimens in a single day in Bardolph Fen, Norfolk; a few also were taken at Benacre, in Suffolk" (*British Butterflies*, p. 47). In 1828, Stephens wrote of this species as follows:—"This splendid insect appears to be confined to the fenny counties of Cambridge and Huntingdon, with the neighbouring ones of Suffolk and Norfolk, unless the account of its capture in Wales by Hudson be admitted; but this may probably be the following species (*hippothoë*), which may, moreover, eventually prove synonymous with *L. dispar*. In the first two localities it appears to occur in great profusion, as several hundred specimens have been captured within these last ten years by the London collectors, who have visited Whittlesea and Yaxley Meres during the month of July, for the sole purpose of obtaining specimens of this insect, which is also stated to occur on the coast of Suffolk, at Benacre, but that locality, may, however, belong to the next insect (*hippothoë*)" (*Illus. Brit. Ent.*, i., p. 82). It is very dubious for which of the "coppers" Stephens' *hippothoë* was meant. One would, on reading his comparison of it with *L. dispar*, be inclined to agree with him that it was an aberration of the latter, "the female of *hippothoë* differing from that of *L. dispar* in having the spots on the uppersurface of the anterior wings smaller, and in having the entire disc of the posterior wings above dusky, clouded with deeper spots, and without the fulvous nervures; the undersurface has fewer and smaller spots than *L. dispar*." The general remarks that follow, however, tend to lead one to the conclusion that he had imported continental specimens of *hippothoë* (like those of *chryseis* and *virgaureae*, which Stephens also describes); for he writes of the insect, described under the name of *hippothoë*, "The inferior size of the above insect, as well as the differences in the number and size of the ocellated spots on the lower surface of the wings, and the colour of the uppersurface of the inferior ones of the female, combined with the circumstance that, amongst several hundreds of *L. dispar*, which have been taken at Whittlesea Mere, not one specimen occurred agreeing with the above definition, seem to point out the present insect as a different species. The male which I possess was in the late Mr. Beckwith's collection, and the female is in that of Mr. Haworth, who informs me that he obtained it many years since from an old cabinet that was formed by a gentleman residing in Kent, and which contained scarcely any insect that was not the production of that county, hence called the 'Kentish Cabinet,' which renders it probable, as Mr. Haworth surmises, that the true locality of the insect is Kent." So little care was taken in those early days to separate British and continental specimens that one is driven to conclude that this must have been an importation, nor should it be overlooked that it was *hippothoë* and not *dispar* that was in these early days recorded from Kent. That either Stephens' or Haworth's specimen was a Kentish *hippothoë*, we do not for a moment believe. The description suggests somewhat that the species might possibly be the *rutilus* form of *C. dispar*, but our actual knowledge of the matter is nil. It may be further argued that there is something to be said in favour of considering these smaller, dark specimens to be really British (but not Kentish) specimens of the *rutilus* form, for Mr. G. Bethune-Baker states that this form was undoubtedly taken in

Britain. He writes:—"I have known for many years that my father took both ordinary *C. dispar* and var. *rutilus* some time between 1825 and 1834. My father tells me he captured all his specimens (eight in number) himself, all of which are in my collection, *viz.*, five ♂ s and three ♀ s. One male is typical *rutilus*, another almost typical, but with slightly larger spots, whilst a third is midway between *dispar* and *rutilus*, the remaining two are true *dispar*. Of the females, one is fairly typical *rutilus*, another is on the upper side like the darker specimens occasionally taken on the continent, *viz.*, with larger spots on the upper wings, but the spots beneath are decidedly larger than any of my var. *rutilus*, whilst the third is true *dispar*" (*Ent. Mo. Mag.*, vol. xxviii., p. 190), and Mr. Sheldon has since questioned (*Ent. Rec.*, viii., p. 114) whether three examples in the "Tugwell coll.," catalogued as taken in "Say and Seal Park," were anything more than normal *rutilus* of the continental type. About 1833, Geyer, in his continuation of Hübner's *Sammlung Europäischer Schmetterlinge*, pl. cxcv., figs. 966-8, gave some very good drawings of the British form of the insect under the name of *hippothoë*. But the day of extinction was not very remote, for, in 1847 or 1848, the last capture of this species in Britain was made by Mr. Stretton, who took five specimens in Holme Fen. In 1899, Merrin recorded (*Ent. Rec.*, xi., pp. 208-209) two reputed Monmouthshire examples, but, like the famous Langport (Woodland) and Weston-super-Mare (Crotch) specimens reported to have been taken in Somerset early in the nineteenth century, and the specimen noted from Worcestershire in Hastings' *Illus. of Nat. Hist. of Worcestershire*, p. 138, one would like more authentic information. Thenceforth, all references to British *C. dispar* are in the nature of reminiscences of what the insect was. Many of these reminiscences are interesting. One of these was penned by Mr. Sam. Stevens, who writes, "I well remember, at the meeting of the British Association at Cambridge, in the year, I think, 1844 or 1845, I was introduced by Mr. Vernon Wollaston, or the Rev. Hamlet Clark, to a man of the name of Rawlinson, the 'Pie-man,' as he was called. He used to go out for gentlemen of the university, to collect for them in the Fens—plants, insects, and other objects of natural history—in the summer time, but in the winter he sold pies. Rawlinson asked me if I wanted caterpillars of the large copper; I said I could do with a few. Two days afterwards he brought me a dozen; I told him six would be enough, which I purchased of him at the price he asked, sixpence each. I took them home and bred five fine and perfect specimens. At that time one could buy the butterfly, from Argent and other London dealers, at 1s. and 2s. each. If one could only have anticipated what has happened, I should certainly have taken the dozen caterpillars and laid in a large stock of butterflies, for a little fortune might be made out of them" (*Science Gossip*, 1894, p. 20). Another reminiscence, which, written as it was by a professional collector (the late, "old Harding," of Deal), has a pathetic interest, as it tends to do away with the pleasant fiction, in the belief of which we have all made ourselves comfortable, that collectors had no direct hand in the extermination of this beautiful species, but that the untoward result was brought about by the drainage of their haunts. This, however, is what Harding has written:—"About forty years ago Mr. Benj. Standish (the grandfather) heard that *dispar*, as then called, had

been seen in the fens . . . . He got a painting of the butterfly, coloured by his father, and went down to the fens and showed it to people there, but no one knew anything about it. Mr. Drake, at the 'Checkers,' told him that a man lodged there who worked in the fens, cutting reeds, who was a most likely person to know. When the man returned from work Standish showed him the drawing and said, 'Do you know anything about a butterfly like this?' 'Yes,' said the man, 'I saw some to-day.' 'Well,' said Standish, 'what shall I give you to take me to the spot.' 'No,' said the man, 'I intend to take a lot up to London.' Standish then offered him five shillings to take him to the place, but the man would not divulge the locality, even for a promise of two shillings for each insect captured. The landlord, however, told Standish where the man worked, and he was successful in finding the place and took a fine lot of *P. hippothoë*. It soon got wind among the folks at the fen that they were worth two shillings each in London, and two men came from Cambridge and secured a large quantity, which they took to London in boxes full and sold them at sixpence each. I went down about three years after and got some of the larvæ. They appeared to be very local, and most numerous where their foodplant—the water-dock—was most abundant. The larvæ were collected by all persons, young and old. I bought two dozen larvæ of an old woman for ninepence, from which I bred some fine specimens, and sold them at one shilling each. Mr. Cole, at Holme Fen, took a large quantity of them. His back-yard was quite close to their locality. The last time I was there Mr. Cole said he had not seen one for some years. There was the foodplant in plenty on the same spot but no larvæ. They had been too closely hunted for" (*Ent.*, xvi., p. 130). The facts that its foodplant existed "in plenty" long after the insect had gone and that "the larvæ had been too closely hunted for," speak volumes. The records of more recent authors are, of course, all culled from the ancient publications. Even as late as 1857, Stainton gives two species of British coppers, besides *Chrysophanus phlaeas*. These are: (1) "*Chrysophanus dispar* (large copper), and (2) *Chrysophanus chryseis* (the purple-edged copper)." Of *C. dispar* he writes: "1″, 7‴. Bright copper-red, with one or more black spots on each wing; hind margins black. U.-s.—H.-w., pale blue, with distinct black spots, vii-viii. Larva green, with a darker dorsal stripe, and one paler stripe on each side (Freyer). On *Rumex hydrolapathum* (great water-dock) and *R. aquaticus*, vi. Formerly found at Whittlesea Mere and Yaxley" (*Manual*, i., p. 55). Stainton then quotes Mr. Bond as follows: "You are quite right in supposing that I have had personal acquaintance with living *C. dispar*. I much fear that I shall never have the pleasure again, as I am quite sure they have disappeared from the Cambridge and Huntingdonshire fens. All I can tell you about their habits is this, that they were very active and shy, and would only fly when the sun shone; they would always settle on a thistle when they could find one in bloom, flying off to attack any insect, no matter what, that might come anywhere near them; not always returning, but generally passing on to another place. It was very little use following them if you missed your first stroke with the net, as they went away like the wind, and seldom let you get a second chance; indeed, it was difficult to follow them, as keeping your eyes on them and the boggy places was rather a difficult

job." Newman (1871) adds a little. Among other things he says: "Varieties of this species are not common; in those that have passed through my hands there has been a remarkable uniformity of colouring, but Mr. Dale informs me that he possesses a female almost entirely black." He then adds, "My acquaintance with the caterpillar and chrysalis was made very many years ago, in Mr. Doubleday's garden at Epping, where the very plant of *Rumex hydrolapathum*, on which the caterpillars fed, is still in existence." The present writer believes that he possesses, thanks to the great generosity of Dr. Chapman, one of the very last specimens that Mr. Doubleday bred on that plant. Of the variability of the dates of appearance, Mr. Newman gives the following facts: "CATERPILLARS appeared at the beginning of June, 1841; July 24th, 1827. CHRYSALIDS on July 25th, 1827. BUTTERFLIES, June 25th, 1826; July 3rd-5th, 1833; July 19th, 1827; August, 1819; August 4th, 1821." These dates were obtained from Mr. J. C. Dale. Newman had quite given up the idea that this beautiful species had ever occurred anywhere except in the counties of Cambridgeshire and Huntingdonshire. In the former county he says it was taken "in plenty at Whittlesea Mere (J. F. Stephens); not taken in Cambridgeshire since 1845 (Thomas Brown)." Of its occurrence in the latter county we read: "Yaxley and Holme Fens. The latest capture, consisting of five specimens, was made by Stretton, in either 1847 or 1848; they were all purchased by Mr. Harrington. I was at Yaxley for several successive years after this, but never saw another specimen or heard of another being taken" (F. Bond). Newman does not give Norfolk and Suffolk, to which counties we have already referred as producing specimens, on the testimony of Stephens and Mr. C. W. Dale, but there is no reason to doubt the former occurrence of the insect in these counties. There is one little item in the history of *C. dispar* which we have not been able to fathom. This originates in a report of the meeting of the South London Entomological Society, held on March 9th, 1893, where we read that "a discussion arose as to the the occurrence of *Polyommatus dispar*, Haw., at Camberwell, fifty years ago, and Mr. Fenn and Mr. Tugwell, both recorded probable Kentish specimens previous to 1848" (*Ent. Rec.*, iv., p. 121). We have already quoted what Stephens says of a species of "large copper," supposed to have been captured in Kent, long antecedent to the date of his work (1828), and which he described under the name of *hippothoë*. The only other reference that we can find bearing on the subject is a quite recent paragraph, which is rather more detailed than Stephens' remarks, although evidently referring to the same specimens, by Mr. C. W. Dale, who writes: "It (var. *rutilus*) has been recorded as British under the name of *hippothoë*. Concerning this my father wrote in *Loudon's Magazine* for 1834: 'Mr. Haworth told me that they came out of an old cabinet called the 'Kentish Cabinet,' and were said to have been taken near Faversham. I had a male and a female from the late Mr. Latham, which were from Capt. Lindegren's cabinet, whence, probably, all the supposed British specimens came'" (*British Butterflies*, p. 46). This is all we can find relating to Kentish specimens of *Chrysophanus dispar* except what we have already noted (*anteà* p. 422). Some of the impossibilities relating to the records of the occurrence of this species may be mentioned. We have already stated that Donovan considered that specimens were taken in Scotland, whilst Haworth records

it as having been taken formerly in Wales by the celebrated botanist, Hudson. Mr. J. B. Hodgkinson, of Preston, states in the *Entomologist's Weekly Intelligencer*, vol. iv., p. 10 (1858), that he saw a specimen "in Cumberland," that he took "a very deliberate look at it and lost it after all." This set the ball rolling, for, in the same Magazine, p. 131, Mr. W. Winter, of Ranworth, says: "This species has again appeared in the fens here; I saw four yesterday, but missed them all." This was on June 19th, 1858. One is recorded (*Entom.*, vol. vi., p. 221) as having been seen on Hackney Marshes. I doubt whether any one of these (and others not mentioned) has a suspicion of probability in it. For very many years it was fondly supposed that we had this fine species all to ourselves, as it was well known that Duponchel's (*Hist. Nat.*, i., xiii., 3-6) and Boisduval's (*Icones*, i., x., 1-3) figures, described under Haworth's name, were from British specimens; but, when Staudinger's *Catalog der Lepidop.*, etc., was published in 1871, it was found that, although *C. dispar* was confined to England, yet it was only a form of a species well distributed over the continent. This latter was the *rutilus* of Werneburg (*Btr.*, i., p. 391), the *hippothoë*, of Hübner (figs. 352-4), Ochsenheimer (1, 2, 83), Godart (1, 9 sec. 5, 10 sec. 3), and Freyer (127). It had, by then, been captured in "France, Germany, South-Eastern Europe (citr. Graecia), Bithynia, Armenia and the Altai." Kirby also considers the true *dispar* type confined to England. The var. *rutilus*, which occurs on the continent of Europe, is diagnosed by Staudinger as being smaller, with smaller spots; but, as the British specimens of *dispar* vary greatly in size, and, as some are certainly not larger, and others much smaller, than large *rutilus*, some other distinction was necessary. This was apparently provided by Mr. Howard Vaughan, who drew attention to the much broader hind marginal orange band on the underside of the hindwings in British specimens of *C. dispar*, when compared with var. *rutilus*. Lang says that all the continental specimens which he has seen "belong to the var. *rutilus*, and are so distinct that there ought not to be any confusion between them and the true typical form once taken in England." He further adds: "The most distinctive feature of *rutilus*, however, is the narrowness of the orange band on the underside of the hindwings, near the hind-margin. I have examined a great number of specimens of *rutilus*, and also of *dispar*, with the object of fixing upon some constant character by which they may be differentiated, and have never seen a specimen of *rutilus* with the hind marginal band so broad and so well defined as it always appears in *dispar*. I am, therefore, inclined to look upon this character as diagnostic" (*Butterflies of Europe*, p. 91). This was all delightfully clear, and those who had invested their gold in British "coppers" breathed freely again, for it had been just recently asserted that a form, quite undifferentiable from British *C. dispar*, had been found in the Pontine Marshes near Rome, and in Egypt (!), and it is well known—such are the peculiarities of rare (and even extinct) British species—that the occurrence of the same form abroad would at once be accompanied by a great increase in the number of *bona-fide* British specimens. The latest disturbance, however, on the "copper" horizon was started by Mr. Bethune-Baker, who asserts that he has specimens of var. *rutilus* of undoubted British origin, captured in the Fens years ago with the ordinary *dispar*. Of course, this is, from a scientific point of view, the most natural thing possible, for there is no doubt that all local forms of a species will occasionally appear as

chance aberrations in all localities where the species occurs under other variations. But it is unfortunate from the speculator's point of view, for now he cannot insist that the var. *rutilus*, which are occasionally offered for sale as British, are not in reality so. Two undoubted var. *rutilus* were offered for sale as British, in the auction rooms, and, we believe, purchased as such, on April 13th, 1896, and *pace* Lang, our own powers of discrimination are not at all equal to the task of separating some undoubted British *dispar* from undoubted Continental *rutilus*. Mr. Bethune-Baker's remarks are quoted *in extenso* in an earlier part of this paper. There are still some hundreds of British *C. dispar* in existence, but every year lessens the number. Accident, and the falling of old cabinets into a neglected condition, are the two main causes of the reduced numbers. Hence the price of *C. dispar* will always be on the up-grade. When we commenced to collect, in 1871, no dealer's list priced the finest *C. dispar* at more than 15s., and anything over a pound for a good specimen was looked upon as exorbitant. Slowly and surely as the number of specimens has decreased, and the number of buyers has increased, the price has steadily advanced, until now £5 5s. for a really fine male, and £5 10s. for a really fine female, can be looked upon as ordinary market prices. In the sale of the "Burney" collection, in 1896, males touched £6 10s. and £5 15s., whilst females reached £6 10s., £6, and £5 15s. In the "Fry" collection, in 1896, 8 ♂s produced £36, and 6 ♀s £30 5s., whilst £6 15s., £6 6s., and £6 per specimen were reached; also in 1896, a fine ♀ in the "Tugwell" collection went for £6, and a large ♂ produced £7 7s.; a female aberration of *C. dispar* in the "Howard Vaughan" collection for £6 10s. In the "Briggs'" collection, sold in 1896, the highest prices were, for a ♂ £5 10s., for a ♀ £5, whilst a record price of £8 8s. was produced by a specially fine example. In the "Stevens" collection, sold 1900, 14 examples produced £71 15s, the lowest price being £2 for a dwarf ♂, whilst a fine example of the same sex brought £8, other examples produced £6, £5 15s., £6 5s., £6. In the "Crowley" collection, sold 1902, the highest price for ♂s was £5 10s., and for ♀s £6 and £7 per specimen. In the "Mason" collection, sold 1905, 16 specimens produced £80 6s., the highest price being £8 for a fine ♀ in which the basal spots of the forewings were united. High as these prices are, they are nothing to what may be expected in the not very distant future, when "coppers" may produce figures more nearly approaching the prices that have been given for Great Auk's eggs. To anyone who can see the humorous side of things there is much to be amused at when the sale of *C. dispar* is on. There is the professional, who will give a couple of guineas for any specimen, in the poorest condition, if perfect; but who will not look at the most brilliant example if it has an antenna missing. He knows his market, and he never buys the latter. Then there is the keen amateur, who bides his time, watches the sale of the less important collections, and tells you he has a series of 10 or 12 specimens, for which he has not paid more than £2 or £3 each, and which are quite as fine and perfect as specimens which, in better known and better advertised collections, have produced about £5. Then there is the wealthy collector, who must have the specimen, and simply runs all opposition

off its legs. It may be urged that this is derogatory to science, and that we should not descend to these particulars. We can but reply that this is the only method left now by which one can collect British *C. dispar*.

Variation.—The Doubleday collection contains 15 British-captured ♂ s and 13 ♀ s of this species. In size there is very little difference in the sexes, the variation in both running from about 33mm. to 47mm., but no chance of exact measurement exists. In colour, one of the ♂ s is rather more orange-yellow than the rest. All have a well-developed discoidal spot on the forewing, and all but one show some trace of a second spot between the discoidal spot and wing-base. In some this spot is very faint, in others very well developed. Among the 13 ♀ s there is distinctly more variation, *e.g.*, there is considerable difference in the size of the spots forming the submarginal row crossing the forewings, some being quite twice as long as the others, whilst, in all, the tendency is to elongation in a longitudinal direction. Three examples have two spots between the discoidal and the base, one other has an exceptionally large discoidal spot, whilst the two spots between this and the base are united into a long, somewhat wedge-shaped, streak, filling up the greater part of the discoidal cell, and with the point towards the base (=ab. *cuneigera*). The hindwings of the ♀ s vary greatly. The most marked form is that in which the basal and central areas of the hindwings are entirely black, except for the fine coppery-red nervures which run up from the outer marginal coppery-red band towards the base: this black area includes the black spots which are not distinguishable therefrom. Others have the basal and central areas (particularly the latter) distinctly paler, the tint being rather of a brown than blackish, tinged with coppery, the two transverse rows of spots black, each spot united with its fellow between the same pair of nervures, into longitudinal streaks. In some others the basal area is quite golden, *i.e.*, the golden gloss overlies a somewhat brown ground colour, the spots black and distinctly forming two rows; lastly, some have the whole central and basal areas golden-brown with no distinct line of demarcation between the colour of the outer coppery-red band and central and basal areas; the spots forming the two transverse rows in these specimens are usually very small, and one ♀ has only the inner row of spots. When these black spots fail, it is usually the outer row that tends to disappear first. The undersides of two examples have the hindwings of a delicate pale grey-blue, the black spots on the fore- and hindwings being surrounded with white. Dale writes (*Ent.*, xxvii., p. 60): "There is considerable difference in size, the smallest in my collection measuring 1 in. 5 lin. across the wings and the largest 2 ins. 2 lin. It also varies in outline, and, of two ♂ s taken at Trundle Mere, in Hunts, the forewings of one are long and acute and of the other short and obtuse, but they do not differ in any other respect. The ♂ is of an effulgent coppery colour, with a larger and a smaller black spot on the forewings; in the var. *rutilus* the second spot is absent*; this variety has been occasionally taken in England in company with the type, and Haworth recorded it under the name *hippothoë*. There is considerably more variation in the ♀. This sex has two larger black spots above the centre of each forewing, and a

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* This is not necessarily so (see *posteà*, p. 430).

row of seven between the centre and the hindmargin, which is broader than that of the male. The outer row of spots are elongated, like those of *Lycaena arion*, but vary somewhat in size, and I have a specimen in which the two middle spots of this row are larger than the rest. The hindwings of this sex are of a brown-black above, much irrorated with copper, the veins being copper-coloured, and running into a broad copper band near the hinder extremity, the edge itself being brown, with six triangular black-brown spots extending into the copper band, and giving it a lobed appearance. The hindwings of some specimens are almost black, and, being hardly irrorated with copper at all, the broad copper band stands forth very distinctly. I have one grand variety, almost black, with the markings much suffused. Mr. Sidebotham had a variety of the opposite extreme, being of a silvery-white, like the var. *schmidtii* (=*alba*) of *C. phlaeas*." Giard notes that a large variety approaching *dispar*, and similar to the specimens of the first brood found in the Bordeaux region, occurs in the Somme district. Of these Bordeaux specimens, Brown notes (*Le Naturaliste*, 1880, no. 23, p. 180) that the examples of the second brood are not at all remarkable, agreeing with those described and figured by Godart, whilst the specimens of the first brood answer in size and brilliancy of colour almost exactly with the two figures that Duponchel gives of *P. dispar*, and the difference is so insignificant as to be almost imperceptible. Gaschet says that, although the Bordeaux examples are like *dispar*, there is some little difference, but Brown states that he cannot see any real difference, and curiously suggests that English *dispar* were simply specimens of the first brood, whilst those of the second, being small and incomparably less beautiful, were not required, and so not collected. Verity observes (*Ent.*, xxxvii., pp. 56-7) that, of three specimens captured in the small marshes that extend along the coast of Tuscany, the two ♀s he possesses, differ strikingly from specimens from Modena and other localities, by their smaller size (one not being larger than a good-sized *phlaeas*), and by the minuteness of the spots on the forewings (see *Ent.*, xxxvii., pl. iv., fig. 12). This specimen looks very like the small second-brood examples of the species from Hungary, Servia, etc. Fleck notes (*Lep. Rumaniens*, p. 16): "In Roumania, the spring specimens are generally far larger than those of the second generation, from which they also differ somewhat in colour. This large spring Roumanian form, of which the females reach 42mm. in wing expanse, has been named *vernalis* by Hormuzaki; the ♀ form, *sagittifera*, of which two examples have been taken at Kloster Neamtz, may possibly be referred to the var. *auratus*." Rühl also reports the specimens taken in the Province of Saxony as being very large. On the other hand, Blachier says (*in litt.*): "The specimens taken by Rehfous at Glanon-sur-Saône, in August, 1905, were of small size, expanding only 30mm.-31mm." He further says that he "also possesses, from near Bordeaux, a very small specimen of only 26mm. expanse, whilst Verity has recorded one of only 25mm. from Spezia." He further adds that all the French examples he has seen have been "of small size, usually 30mm. or less, whilst examples taken near Berlin at the end of June, 1901, were much larger, the largest ♂ measuring 35mm., the largest ♀ 40mm." Blachier then observes that a pair coming from the Altai mts., have a similar appearance and shape to the German examples, the ♂ with a well-marked black spot in the middle of the discoidal cell of the upper

wings, as in the ♀, but he believes that this detail is found in certain European examples. Miss Fountaine found a very small form of the butterfly common around Kavaran Szakul at the end of July, 1898, whilst near the Kammerwald, in August, most of the specimens were much larger. Courvoisier notes (*Mitt. d. Schweiz. Ent. Gesell.*, xi., p. 22) of the Lycænid variation, certain "formæ confluentes multiplices," with subdivisions—"(1) 'Forma radiata *a*' illustrated by *phlaeas* ♂, having the discoidal spot confluent with the transverse row of spots, leading to confluence of the basal spot with the discoidal as well. It appears to be more frequent in *hypophlaeas* than with us, and has been named *fasciata*." "(2) 'Forma radiata *b*' illustrated by *rutilus* ♀, having the transverse line of spots confluent with the outer marginal lunules, leading on to confluence between the discoidal spot and marginal lunules and even between the basal and discoidal spots." He describes another group as "Formæ luxuriantes," illustrating his sect. *e* of this group again by "examples of *rutilus* ♂ ♀, in which extra spots appear in situations otherwise spotless, and, in this species, sometimes, form elongate dashes at the base of the wings." Leonhardt observes (*Ent. Zeits. Guben*, xviii., p. 53) a ♂ with albinism developed on the outer and inner margins of the right forewing; taken in Upper Alsace near Hüningen. In the British Museum coll. the British ♂ s (six) of *dispar* follow those in the Doubleday coll., so far as the spots between the discal one and the base is concerned, *viz.*, two have a distinct extra spot, one has none, and three have very faint traces, whilst all more or less show sufficient brilliancy on the outer margin of the hindwings to suggest the band that is so distinct in the ♀. Five of the seven ♀ s are richly coloured, two are distinctly yellower in tint, a feature quite common in the German *rutilus*, yet not characteristic of the type as described by Ochsenheimer. This paler-tinted form we call ab. *subcuprea*, n. ab. In all the British ♀ s the spots on the forewings are large. Three of these ♀ s show only one largish spot between the discal cell and the base, three others show a second small spot, whilst one specimen has this second spot developed into a wedge-like streak, ending in a fine point towards the extreme base of the wing, but not united with the normal spot between the discal spot and the base as in the ♀ in the "Doubleday coll." already described as ab. *cuneigera*. In the *rutilus* in the British Museum collection this second discal spot is rare, and in none is the wedge-like streak developed. Of the submarginal series of spots, the two middle ones are considerably elongated in three of the British examples, but variation in this direction is much more frequent in the long series of ♀ *rutilus* from Germany. On the whole, these latter examples have much smaller spots in this submarginal series, but they show so complete a gradation that one might group them as: (1) ab. *sagittifera* (with all the spots much extended, the 2nd and 3rd from the costa almost or quite reaching the discoidal spot, the 4th and 6th sometimes with somewhat dot-like endings); (2) ab. *excessa* (the spots extended, with small separated spot extensions at their inner ends); (3) the typical form (with fair-sized spots); (4) ab. *parva* (with small spots); (5) ab. *subobsoleta* (with disappearing spots); (6) ab. *obsoleta* (with the series quite absent). Still more remarkable, however, is one example (originally from the Leech coll.), with the spots sufficiently united to form an almost transverse band (=ab. *transversa*). This, with another example from the same collection, looks as if it had been reared under unsuitable environmental conditions, the bands being broad,

the dark colour somewhat faded, and the outermarginal copper band on the hindwings much reduced. The German *rutilus*, too, are very variable in the hindwings, and show gradation in colour from wholly brown-black (extending from the outer marginal copper band to the base, with scarcely even a trace of copper nervures, and no trace whatever of the transverse rows of spots), to the hindwings having the same tint as the forewings, presenting only a marked discoidal lunule and slight fuscous shading towards the base and along the inner margin, with barely a trace of, or no, spotting anywhere in the ground colour; intermediate stages have well-marked nervures, and one, or two transverse rows of spots are, of course, frequent, although, as a rule, the spotting of the hindwings in German *rutilus* tends to obsolescence, so that the hindwings of the ♀ s may vary in: (1) having the whole area from hindmarginal band to the base uniformly blackish-brown (=ab. *nigrescens*), (2) ditto, but with fine copper nervures (=ab. *neurata*, n. ab.), (3) with the outer portion divided into marked wedge-shaped spots (=ab. *cuneata*, n. ab.), (4) with the basal area somewhat paler and two rows of transverse spots showing (=ab. *bilineata*, n. ab.), (5) ditto, with only inner row of spots (=ab. *unilineata*, n. ab.), (6) with the hindwings almost unicolorous and unspotted (=ab. *suppressa*, n. ab.). The absence of the fine discoidal lunule on the hindwing of the ♂ is rare; it is practically absent in a specimen from Silesia, quite absent in an example from Greece and another from Bosnia, whilst both this and the discal spots of the forewings are absent in some examples of var. *auratus* from Korea. The much less brilliant ground colour of both fore- and hindwings, especially in the ♀ s, the want of intensity in the dark markings, the broader bands, the darker nervures, and the more uniform-sized spots on the forewings, and the rather dull, uniformly-tinted, basal and median areas of the hindwings, appear to be characteristic of the Eastern European and Western Asiatic races. The females of the *auratus* form from Korea are of the *subcuprea* tint, *i.e.*, inclining to flavescent in colour In size, there is considerable variation, the smallest European examples that have come under our notice are a ♂, 27mm., and a ♀, 31mm., from Germany, in the British Museum coll. We have others nearly as small from Buda-Pest and Belgrade, and would consider anything under 34mm. as being exceptionally small (=ab. *minor*, n. ab.). Lowe says that 2 ♂ s taken at Neu Breisach, June 14th, 1901, measure respectively 29mm. and 39mm., the two ♀ s 31mm. and 37mm., and adds that here they vary much in size, and are small compared with English *dispar* and Berlin *rutilus*, for he has a ♀ from the latter locality measuring 42mm.; we have seen examples from Spandau, near Berlin, expanding 48mm. The smallest British example in the British Museum collection is a ♀ of 39mm. expanse. Fenn notes that the measurement of fifteen British examples in his collection run—♂ s,— 1in. 3lin., 1in. $7\frac{3}{4}$lin., 1in. 8lin. (2), 1in. $8\frac{1}{2}$lin. (4), 1in. 9lin. (2), 1in. $9\frac{1}{2}$lin.; ♀ s—1in. $7\frac{1}{2}$lin., 1in. $8\frac{1}{2}$lin., 1in. 9lin., 1in. 10lin. [We have a ♀ rather larger than the largest of these, *viz.*, with a wing-expanse of 49mm.] Of these examples, Fenn notes that, "four of the males have, on the upperside, a more or less pronounced second spot between the central discal spot and the base of the forewing; the black central lunule on the hindwing also varying greatly in intensity. Of the ♀ upperside, the general variation is—in the marginal blackish band of the forewing, which is deflected at a greater or less distance from the anal angle, and in the

intensity of a 3rd spot between the two central (subdorsal) spots and the base. In one specimen this 3rd spot is obsolete. The hindwing of the ♀ in some examples has a distinct row of spots below the central spot, but these are often lost in the black radii. The spots on the underside of both sexes vary considerably in size." Edwards has two, the measurements of which are ♂ =44mm., ♀ =46mm. Raynor has a ♀ in his collection in which the two large discal spots on the forewings are joined together by a narrow black neck, constituting n. ab. *punctijuncta*; expanse of wings 44mm. We have already noted one in the Doubleday coll. (and another, rather less developed, in the Brit. Museum Coll.) in which the second discal spot is united with the third, and then continued onwards to the base as a large wedge-shaped spot = ab. *cuneigera*. It would be interesting to know the cause of the change in ground colour in two ♂ s in our own collection, both being of a dull tawny-brown instead of the normal copper colour = ab. *brunnescens*. We have seen no others like them. They came into our possession many years ago, and were of this same peculiar tint then. We have also in our collection a British ♂ reputed to be the last example bred by Doubleday in his garden at Epping. It is slightly weakened on the left side, and has a small pallid patch towards the middle of the outer margin of the left forewing, whilst the margin of the left hindwing is also rather pale, but the most remarkable feature of this example is a most beautiful and delicate purple tinge on both hindwings, but most marked on the right, extending from the inner side of the obsolete outer marginal band well on towards the base, reaching beyond the discoidal cell, as well-developed purple wedges = ab. *purpurascens*, n. ab. This development of a purple tinge in this species is most unusual. The races and aberrations of this species that have been already described are as follows:

*a.* var. *rutilus**, Wernebg., "Beit.," pp. 243, 391. 494 (1864); Staud., "Cat.," 2nd ed., p. 8 (1871); Kirby, "Eur. Butts. and Moths," p. 55, pl. xiv., fig. 12 (1879); Lang, "Butts. Eur.," p. 91, pl. xx., fig. 1 (1881); Rom., "Mém.," i., p. 50 (1884); Locke, "Soc. Ent.," iii., pp. 12-13 (1888); Rühl, "Pal. Gross-Schmett.," pp. 209, 745 (1892); Horm., "Soc. Ent.," viii., pp. 58, 130 (1893); Tutt, "Brit. Butts.," p. 150 (1896); Staud. and Reb., "Cat.," 3rd ed., p. 73 (1901); Wheeler, "Butts. Switz.," p. 13 (1903); Reb., "Ann. K. K. Nat. Hof. Mus.," p. 185 (1903);

* This is purely a "nov. nom." with no independent description or even explanation. Werneburg has shown earlier in his work (*Beit.*, p. 243) that the true *hippothoë*, Linn., is *chryseis*, Ochs., and this obviously leaves *hippothoë*, Auctt., in need of a new name. When Werneburg comes to the tabular comparisons of the works of Schiffermüller and Fabricius this is supplied, for he gives (*op. cit.*, p 391):

| Wien. Verz. 1775. | Gen. Ins. Mant. 1777. | Spec. Ins. 1781. | Mant. Ins. 1787. | Ent. Syst. 1793. | Name in other Authors. |
|---|---|---|---|---|---|
| M. 2. Hippothoë (20). | 353-54. Hippothoë. | 568. Hippothoë. | 723. Hippothoë. | 172. Hippothoë. | Rutilus, M. Hippothoë, O. |

Werneburg's note 20 (on p. 494, at the end of the tables) says: "*Hippothoë*, W.V., is without doubt = *hippothoë*, O., for, as the Viennese entomologists give also, in addition to this butterfly, *virgaureae*, *chryseis*, and *hipponoë*, O. (*lampetie*, W.V.), distinctly denoted, there remains no choice." Fabricius, in 1777 and 1781, obviously mixes up *hippothoë*, O., and *chryseis*, O. He first separates the two in 1787. Thus the diagnoses of *rutilus* will be successively, Schiff., "Wien. Verz.," Fab., "Mant.," p. 723, and Ochs., "Die Schmett.," i., p. 84, and especially the latter, as that is actually bracketed with the n. nom. in the synonymy, and appealed to for the determination of the older authors. We therefore use this description above for this particular form.

p. 180 (1904); Gillm., "Ins. Börse," xxiii., p. 23 (1906); Zobel, "Ins. Börse," xxiii., p. 48 (1906). *Hippothoë*, Schiff., "Wien. Verz.," p. 181, no. 2 (1775); Fab., "Gen. Ins. Mant.," pp. 353-4, *in part* (1777); "Spec. Ins.," p. 568, *in part* (1781); "Mant. Ins.," p. 723 (1787); "Ent. Syst.," p. 172 (1793); Hb., "Schmett. Eur.," pl. lxx., figs. 352-4 (1799); Ochs., "Die Schmett.," i., p. 84 (1808); God., "Hist. Nat.," i., p. 200, pl. ix sec., fig. 5, x sec., fig. 3 (1821); "Enc. Méth.," ix., p. 668 (1823); Freyer, "Neu. Beit.," ii., p. 55, pl. cxxvii (1836). *Rutila*, Kirby, "Handbook," etc., ii., p. 91, pl. li., figs. 3-4 (1896).—This insect is generally larger than *P. virgaureae* which is closely related to it. The ♂ is, on the upperside, of a glossy fiery colour, with a black costal and outer edge, which is particularly strongly marked at the apex of the forewings; without any bluish sheen, and with black spots on the hindwings. The forewings have a narrow longitudinal central spot, the hind ones, a fine streak; the fringes are white. The ♀ is lighter in colour, with a broader, black, outer edge, two similarly coloured central spots standing abreast, and a bent row of spots on the forewings; the hindwings are brownish-black, with black effaced spots and a glossy red marginal band. On the underside, the forewings of both sexes, are reddish-yellow, bluish-grey towards the edge, spotted, with black on the outer margin, the black spots bordered with yellowish, placed as on the upperside of the ♀. The hindwings bluish ash-grey, darker towards the base, with many black, white-margined spots, and a reddish-yellow marginal band dotted on either side with black spots. This butterfly is found in northern and southern Germany [also in Sweden] (Ochsenheimer).

The name *rutilus* is generally applied to the continental and western Asiatic form of this species. Staudinger (*Cat.*, 3rd ed., p. 73) diagnoses it as: "Maculis nigris minoribus, præsertim subtus"; whilst, in the 2nd edition, p. 8, it was described as "var. minor, maculis minoribus." It was first confused with *hippothoë*, Linn., but there seems to be little doubt that the insects described by Fabricius (*Mant. Ins.*, p. 723) and by Ochsenheimer (*Die Schmett.*, i., p. 84) really belong to this species. In 1821, Godart described (*Hist. Nat.*, i., p. 200) the species from various localities in France, "the ♂ of a 'fauve-ponceau' (tawny-red) with a narrow black border, entire on the forewings, interiorly crenulated on the hindwings; there is also a black discoidal mark near the centre of each wing, that on the hindwing being finer and curved. The ♀ has the upperside bright tawny, with the margins and spots black; the upperside of the hindwings blackish, with a tawny marginal band, hollowed on its outer edge. The underside of both sexes is as in *chryseis*, but the hindwings are bluish towards the base, and there is a black streak in the discal area instead of the two ocellated spots." In 1836, Freyer (*Neu. Beitr.*, ii., p. 55), after referring to Geyer's then recent figure of the larva, says that "the imago on the upperside closely resembles *P. virgaureae*, but the underside is very similar to *P. hippothoë*, only that the hindwings are lighter ash-grey, with a dash of blue, and the ocellated spots somewhat smaller; the ♀ is very different on the upperside from the allied species. The black central spots on the forewings distinguish this butterfly from its allies. It is generally larger than *virgaureae*, but I have here examples that are smaller than that species." He adds that "the butterfly is found in south Germany and Switzerland, and is scarce." In the *Societas Entom.*, viii., p. 58, Hormuzaki observes that "this insect is abundant in two broods everywhere in Bucovina, even up to the mountain region. The examples of the spring brood are larger, reaching to 40mm. in the ♀ s, and coloured more vividly red. In the ♀ s also, the spots on the forewings vary much in form, sometimes being large and circular, at others pointed towards the base; occasionally placed irregularly, particularly the upper three spots (from nervure $M_3$ towards the costa), which are sometimes pushed somewhat out

from their normal position. The inner margin and the base are occasionally blackened very strongly. The hindwings are of an intense black-brown, only the nervures (particularly the branches of the median) vivid gold-red; the red-yellow band of the outer edge is broad and sharply defined; the black spots on the hindwings are scarcely, if at all, discernible from the ground colour. On the underside the hindwings are light bluish-white in both sexes, and, on the forewings, there are occasionally one or two black basal spots, with pale edging, a feature only shown by *P. amphidamas*." He then says that this form is, in his opinion, the typical form *dispar*, Haw., and adds: "The smaller autumnal form appears in August and September, is 28mm.-38mm. in expanse, is less vividly coloured, the row of spots on the forewings being very pronounced, occasionally almost exactly as in the spring form (referred to *dispar*), although, frequently, the spots are dot-like or lengthened. The hindwings are rather grey-brown, with a golden-red gloss, so that the black spots stand out more conspicuously, whilst the red marginal band is less sharply defined. Many specimens, however, are exactly like the spring form. The underside of the hindwings is generally of a more ashy-grey tint; the basal spot is also occasionally present." This form he says is *rutilus*, so that he considers the first brood *dispar* and the second brood *rutilus*, etc. One suspects that the first brood is much more likely to have been the form best known to Ochsenheimer, from Germany, throughout the greater part of which country the second brood is very rare and only partial. Later, Hormuzaki changed his opinion, and named (*Soc. Ent.*, viii., p. 130) the spring form (referred above to *dispar*) *vernalis*, adding that Caradja had told him that the large spring brood specimens of this species which are common everywhere in Roumania (*e g.*, Closter Neamtz, Bucharest, etc.), although resembling *dispar*, were not that form, and he, therefore, advised him to call it var. (gen. 1) *vernalis*. Rühl notes (*Pal. Gross-Schmett.*, p. 744) that three examples of *dispar* he examined, were not larger than *rutilus*, but that larger examples did occur, up to at least 44mm. The ♂, he says, "hardly differs on the upperside from *rutilus*, whereas the ♀ has a broad, black, marginal band, with all the black spots very strongly developed; the base, too, is tolerably broadly, but not strongly, dusted with black, although much more conspicuously so than in *rutilus*. The hindwings are almost entirely deep black, but the red marginal band is very broad and strongly developed, whilst some of the nervures are slightly tinged with red. The underside is much more strongly spotted than in *rutilus*, the front wings also are more heavily marked, much more vividly coloured, the grey of the outer margin, also, is a shade darker, as well as that of the hindwings. The hindwings are not, as usually noted, more dusted with blue, but, on the contrary, the ♂ s are more faintly dusted than are those of the specimens of *rutilus* under examination, whilst, in the ♀ *dispar* before me, there is absolutely no trace of blue, but the marginal band of the hindwings is much broader and more brightly coloured than in *rutilus*." Rebel says (*Ann. Nat. Hofm. Wien.*, p. 180) that the second brood examples, appearing in Bosnia in August, are smaller than the spring specimens. Zobel also exhibited, on September 28th, 1905, at the Berl. Ent. Verein, ♂ s of a second brood of *rutilus*, which, he said, had probably been then bred for the first time in Berlin. Fassl is said to have bred a ♀

of the same brood at the end of August, 1905. Zobel's specimens were smaller, but did not differ in colour and markings on the upperside of the forewings from those of the first brood, but the underside of the hindwings, however, was of a rather blackish blue-grey colour, the marginal eye-spots on the underside of the forewings somewhat elongated into streaks, whilst the base had a second ocellated spot. Rühl observes that the specimens taken near Magdeburg, in Saxony, are very large. Gillmer has a Magdeburg ♂ of 37mm. expanse, and a ♀ of 43mm.

β. ab. *sagittifera*, Horm., "Soc. Ent.," viii., p. 58 (1893); Carad., "Iris," viii., p. 35 (1893).—There is a remarkable and not rare aberration of this autumnal form, which I caught in abundance in the year 1890, in Crasna, and in 1892, in Gurahumora (Bucovina), which deserves special notice. I call it ab. *sagittifera*. As the name itself indicates, in this aberration, all the black spots of the forewings are strongly lengthened inwards into arrow-head marks, so that the two spots in the cells between the third median nervule and the lower margin, and the upper and lower margins, are confluent with the discoidal spot (Hormuzaki).

Caradja says (*Iris*, viii., p. 35) that, in Roumania, *P. dispar* var. *rutilus* takes the place of *virgaureae*, and flies in numbers everywhere in the meadows and pastures, and by the roadside ditches. He says: "I took it near Kloster Neamtz, Agapia, Grumazesti, Peatra, Hango, Bacau, and Slanic, up to 900m. elevation. It has also been observed near Jassy (Coll. Leon), Dulcesti (Hormuzaki), Comanesti (Leon), Bucharest (Haberhauer). The first generation flies in June; the specimens are, on the average, far larger than the examples of the second generation, from which they also, besides, differ in coloration. Hormuzaki named this large spring form var. gen. 1, *vernalis* (*Soc. Ent.*, viii., pp. 58, 130), the ♀s of which measure up to 42mm. The second generation, he says, flies from August 17th up to October. One meets the ♀s very frequently on thistles and *Centaurea* flowers; the ♂s fly uncommonly quickly, going straight ahead, and very seldom settle. As, during flight, they flap the wings together, the brilliant red of the upperside flashes only for the briefest moment in the observer's eye, and the insect is again immediately lost to sight. In the ♀s of the first, as well as of the second, generation, the upperside of the hindwings up to the sharply margined red hind-marginal band is quite dark, and without any red admixture, just as in the var. *auratus*, Leech, from the Amur district and the Korea. The ♀ ab. *sagittifera*, Horm., of which I took two examples near Kloster Neamtz, would be best placed under var. *auratus*. In this beautiful form the golden-red colour of the forewings is mostly darker than in var. *rutilus*, and the black spots are much elongated towards the base in wedge-like forms. The hindwings up to the red hindmarginal band are always intense black-brown. There are, in Staudinger's coll., two typical ab. *sagittifera*, from Taschkend and Lepsa. The species is widely distributed in all the surrounding countries."

γ. ab. *nigrolineata*, Verity, "Ent.," xxxvii., p. 57 (1904).—I propose this name for a new aberration, of which I have a specimen collected near Modena, September 6th, 1900. It may be said to correspond with the ab. *radiata*, Tutt, of *C. phlaeas*, having on the forewings each of the black spots of the subterminal row greatly increased in size and prolonged across the submarginal brown band to the base of the cilia. On the hindwings the black dots are so enlarged and lengthened as to fill up entirely the internervular space up to the edge of the coppery band. The copper-colour also differs greatly on the forewing from that of type, as it is thickly strewn with scales, which give it a much richer reddish tone. These scales are in every respect similar to those that may be seen very thinly strewn here and there on the forewings of some ♀ specimens of var. *rutilus*. On the underside of the

forewing each spot of the submarginal row is greatly prolonged outwardly and ends in a sharp point, which, in the case of the last three spots, blends itself with the corresponding small black dots plainly visible in the type on the inner edge of the hind marginal grey border. The hindwings have nearly no blue at the base (Verity).

Verity's reference to *R. phlaeas* ab. *radiata*, Tutt, is very wide of the mark, as the latter is a purely hindwing aberration (see *antea*, p. 369). His description suggests a very close similarity with the following form, ab. *radiata*, Obth.

δ. ab. *radiata*, Obth., "Variation chez Lépidoptères," p. 8, pl. v., fig. 69 (1896). *Rutilus* ab., Reb., "Ann. Nat. Hofm. Wien.," xix., p. 180 (1904).—The insect occurs at St. Quentin, where the examples approach in size the extinct form from England but without the latter's brilliancy. The only aberration that we possess is that figured pl. v., no. 69. It is the butterfly mentioned by Bellier de la Chavignerie (*Ann. Soc. Ent. France*, 1858, p. 306) with this notice: '♂. —The ocellated spots on the underside replaced on all four wings by long, very thick, black streaks. Germany.' (Oberthür, *Variation chez Lépidoptères*, pp. 8-9).

Oberthür's figure shows a most remarkable aberration, with a series of longitudinal streaks, from 2mm.-4mm. in length, running round all four wings parallel to the margin, formed by the union of the angulated and outer marginal series of dots by black transverse lines. The spots on the rest of the wings are remarkably small. Rebel notes a ♂ from Dervent that corresponds with the ab. *confluens* of *C. hippothoë*, diagnosed by Staudinger (*Cat.*, 3rd ed., p. 74) as "punctis subtus confluentibus."

ε. var. *auratus*, Leech, "Proc. Zool. Soc. Lond.," p. 414, pl. xxxv., fig. 3 (1887); Alph. "Rom. Mém.," v., p. 103 (1889); Staud., "Rom. Mém.," vi., pp. 154-5 (1892); Leech, "Butts. China," ii., p. 397, pl. xxviii., figs. 4-6 (1893-4). Rühl, "Pal. Gross-Schmett.," i., pp. 210, 745 (1892); Tutt, "Brit. Butts.," p. 150 (1896); Staud. and Reb., "Cat.," 3rd ed., p. 73 (1901); Lang, "Ent.," xxxviii., p. 124 (1905). *Hippothoë*, Brem. and Grey, "Schmett. Nord. China," p. 10 (1853). *Rutilus*, Fixsen, "Rom. Mém.," iii., p. 283 (1887). *Dahurica*, Graes., "Berl. Ent. Zeits.," p. 75 (1888).—Expanse of wings, ♂, $1\frac{3}{8}$ inches, ♀, $1\frac{1}{2}$ inches. ♂.—Upper surface of all the wings bright golden copper, with narrow black outer margins, fringes black, except on the inner margin of the hindwings; on the outer margins of the hindwings are six black dots, the two nearest the anal angle being nearer together than the others. ♀.—Forewings golden copper, much suffused with darker scales, margined broadly on the outer border with black; two black discoidal spots, followed by a band of broad black dashes, extending across the wing; hindwing sooty-black, bordered by a broad golden copper band notched at the edges. Underside of both sexes:—Forewings yellowish-buff, bordered on the outer margin with dirty grey, inside of which is a row of seven very distinct black spots; on the disk is a second irregular row of black spots; there are three spots in the discoidal cell, the outer one of which is the largest. Hindwings greyish-buff, outwardly margined by a broad orange band, bordered on each side with a row of black dots; an irregular arrangement of black spots, margined with dirty white, is scattered over the remainder of the wing. I took this species, during heavy rain, at rest on stems of a coarse grass in a swampy gully near the monastery of Chang-Do, about twenty-five miles south of Gensan, in July, 1886. This species is allied to *P. dispar*, but its colour resembles *ochimus*; the fringes are black, the discoidal spots are absent on all the wings of the male, the female has a row of dashes on the forewings instead of spots, and the disk of the hindwings is not suffused with copper; the underside is also different (Leech). [Later he writes: "Alphèraky states that a specimen of this variety was taken in June, 1886, by Potanine, near Hè-Tchèn, in the province of Kansou. He also remarks that the specimens of *C. dispar* recorded by Fixsen, from Corea, as var. *rutilus* are really referable to var. *auratus*. Staudinger considers that var. *dahurica*, Graeser, is identical with my var. *auratus*. It would appear, therefore, that *C. dispar* is represented in east Asia by the *auratus* form only, and I think that the specimens recorded as *P. hippothoë* by Bremer and Grey are probably referable to this form of *dispar*" (Leech).]

Staudinger diagnoses this eastern form as: "♂ supra impunctatus,

♀ al. post. nigricantibus; subtus al. post. griseis, non cærulescentibus." In 1889, Alphéraky, in his account of the "Lepidoptera captured by Potanine in China and Mongolia," writes: "A ♂, taken on June 26th, 1886, near the village of Hè-Tchèn, belongs, without doubt, to *auratus*, Leech, which, however, is only a variety of *P. dispar*, a variety very close to *rutilus*, and from which it is to be distinguished by the narrower black border of the wings, by the absence of the discocellular spot on the forewings, as well as by the tawny antemarginal band on the underside of the hindwings being a little wider. It is certain that the specimens taken by Fixsen, in Corea, and referred (*Rom. Mém.*, iii., p. 283) by him to *rutilus* belong to *auratus*." Of these specimens, Fixsen says that "they vary in size, some being smaller and some larger, yet they do not essentially differ from the *rutilus* of North Germany. The ♀ exceeds the usual form in size, has the ground colour of a darker tone, whilst the marginal band of the forewings, and the black of the hindwings is deeper, and more intense. Flies from July 4th to August 25th, the wing expanse of the ♂ 17mm.-19mm., of the ♀ 18mm. 20mm." The previous year, however, *i.e.*, in 1888, Graeser (*Berl. Ent. Zeits.*, 1888, p. 75) had renamed this eastern form, var. *dahurica*, observing that both sexes of "this very constant local form of *Polyommatus dispar*, were taken in considerable numbers, from mid-July until the commencement of August, near Pokrofka. It differs so distinctly, not only from *dispar*, Haw., but also from *rutilus*, Wernebg., that it deserves to be separately named. So far as the upperside of the ♂ s is concerned, in this variety, the black discoidal spot of the forewings is always absent, and so, too, is the fine black discocellular line of the hindwings. This spot and line are visible in the ♂ examples of *dispar* and *rutilus* before me. The hindwings of the ♀ of this variety are entirely unicolorous blackish-brown, except the red marginal band, never tinged nor streaked with red veins as in *dispar* and *rutilus*. From these again, *dahurica* differs much more conspicuously in both sexes on the underside of the hindwings, which, in this, are not bluish-white, but smoky-grey with a faint silky-like gloss due to the darker ground colour; the white margins of the black dots and spots stand out much bolder than in the other forms. The red marginal band of the hindwings is more sharply defined than in *rutilus*, and extends to nervure VI. On the underside of the forewings, on their outer margins, is a very regular row of black spots, the first of which is at the apex, the last near the inner angle, between the first two nervures. This row of spots is, in *dispar* and *rutilus*, likewise present, but is much more irregular, and less conspicuous. In size, the specimens vary, the ♂ s from 27mm.-37mm., the ♀ s from 31mm.-42mm." In 1892, Staudinger observes (*Rom. Mém.*, vi., pp. 154-5) that "Christoph sent him a ♀ which had been caught in the middle of July near Raddefka (Dörries), a similar one from Askold, a pair from Bikin, and a number of specimens from Sutschan. One of the six ♂ s from the latter district shows traces of the black discal spots on the upperside of the forewings." "Graeser," he says, "caught this insect in numbers near Pokrofka, and calls the European and Central Asiatic forms *rutilus*, whilst he names this striking Amurland form *dahurica*, although a year previously, Leech had described it as *auratus*, from examples taken in Corea, south of Gensan. Of specimens caught by Herz, in Corea (not far from the spot where Leech captured his examples),

Fixsen says that they do not differ specially from the *rutilus* of North Germany, but I suspect that Herz's specimens are also referable to *auratus*, and that Fixsen overlooked the chief distinctive characters, such as the absence of the black discal spot in the centre of the forewing of the ♂ on the upperside, the complete absence of reddish on the dark parts of the hindwings of the ♀, and the differently coloured underside." Leech observes, as already noted (*Butts. China*, ii., p. 397), that he took *auratus* "during heavy rain, at rest on stems of coarse grass, in a swampy gully near the monastery of Chang-Do, about 25 miles south of Gensan, in Corea, whilst Alphéraky (*Rom. Mém. Lep.*, v., p. 103) states that a specimen of this variety was taken in June, 1886, by Potanine, near Hé-Tchèn, in the province of Kansou. He also remarks that the specimens of *C. dispar* recorded by Fixsen, from Corea, as var. *rutilus*, are really referable to var. *auratus*, and that Staudinger (*Rom. Mém. Lep.*, vi., p. 154) considers that var. *dahurica*, Graeser, is identical with his var. *auratus*; so that it would appear that *C. dispar* is represented in Eastern Asia by the *auratus* form only, and he thinks that the specimens recorded as *P. hippothoë*, by Bremer and Grey (*Lep. Nord. China*, p. 10), are probably referable to this form of *dispar*. According to Elwes (*Proc. Zool. Soc. Lond.*, 1881, p. 887), Bremer records *C. virgaureae* from Pekin, but Leech was unable to find the work in which this record is published. Lang notes (*Ent.*, xxxviii., p. 124) the capture of one ♂ and one ♀ of var. *auratus*, on August 8th, 1897, at Vladimar Bay, in Russian Tartary. He says that "these examples exactly tally with Staudinger's diagnosis, '♂ supra impunctatus, ♀ al. post. nigricantibus; sub. al. post. griseis, non cærulescentibus.' Lang thinks that these are nearer the true British type than the Euro-Asiatic *rutilus* in general appearance and size, and in the width of the submarginal band on the underside of the hindwings; but there is only a trace of a discoidal spot in the ♂, and an entire absence of the blue basal shading (on the underside) found in true *dispar*. The hindwings of the ♀, above, more resemble those of ♀ *C. hippothoë*." Our own impression of the *auratus* we have examined is that they are usually very much farther removed from the British *dispar* than most first brood specimens of *rutilus*. As a matter of fact we have examined several European *rutilus* that we could not possibly separate from some undoubted British *dispar*.

Teratological specimens.—The following notes may prove of interest: (1) The upper wings long and acute. (2) The upper short and acute. Both specimens ♂s, and taken near Trundle Mere, in Huntingdonshire. They do not vary in any other respect. [The note was accompanied by a sketch in which the outline of the smaller insect was drawn within the outline of the larger, these outlines exhibiting a very obvious degree of variation.] (Dale, *Ann. Mag. Nat. Hist.*, vii., p. 60). (3) ♂.—Right side normal, the forewing of the left side curved inwards, directly below the apex, on the outer margin; the outer margin of the left hindwing also curved inwards, tending to form a little tail at the anal angle (Tutt coll.). (4) ♀.—Left side almost normal, just a little shortened, giving an appearance of stumpiness, the right forewing slightly hollowed at the middle of the outer margin (Tutt coll.).

Egglaying.—The eggs are laid singly, or in twos, threes, or fours, on the underside of a leaf of *Rumex hydrolapathum*. When the larva

leaves the egg, it gnaws out a circular hole at the apex, extending to the six cells surrounding the micropylar depression, giving the figure of a six-sided crown. As a rule, the ♀ lays its eggs in July, from one to four on a leaf, and where a greater number is found, one may rely on the fact that more than one ♀ has oviposited on the same leaf. This frequently happens owing to the cutting down of the foodplant in July, and the consequent limitation of the leaves on which eggs may be laid. Bartel says that he has found up to twelve on the underside of a leaf (Gillmer). Ova laid singly, more rarely in pairs, or three together, on the undersurface of the leaves of the foodplant. Before emergence the larva eats out a large hole from the centre of the egg, consuming the micropylar pit and parts of the ribs, but after leaving the egg, it does not eat any further portion. The shell, when the larva has left it, plainly shows the great contrast that exists between the stout walls of the egg and its base, or floor. This latter is very thin and transparent, allowing the surface of the leaf on which it is laid to be seen through it (Sich). Nicholson notes (*in litt.*) that he sleeved a ♀ taken June 11th, 1892, at Budafok, over a piece of *Rumex hydrolapathum*, and placed it in the sunshine; although the ♀ was rather worn and had deposited most of her ova, she laid a dozen on June 12th-13th. These hatched on June 20th.

Ovum.—This singular egg is semi-tiarate, very depressed above, flat below (except when it fills a depression in the leaf on which it is laid). On the upper surface, in the centre, is a deep pit, at the bottom of which the micropyle lies. The vertical axis in the centre of the egg only measures 0·26mm., but the ribs rise, above this, to a total height of 0·35mm. At the base of the egg the horizontal axis measures 0·66mm. The central pit, or cell, above mentioned is more or less circular, about 0·13mm. in diameter, and furnished with a very strong wall. On the inner side of this wall there is, occasionally, a ring of small shallow cells. From this wall run either six or seven very strong irregular ribs, which increase rapidly in bulk as they approach the periphery. [With regard to the variation in the number of ribs present in the egg, it is not a question of one ♀ laying six-ribbed eggs, and another laying seven-ribbed eggs, as I have dissected out of the same ♀ both six- and seven-ribbed eggs.] The interspaces between these coarse wide ribs are occupied by a series of three, very large, very deep, more or less circular, cells, placed one above another, the uppermost cells, about 0·08mm. in diameter, forming a ring of either six or seven cells, according to the number of the ribs, round the micropylar pit. The middle cells of the series are larger, about 0·13mm. in diameter, and form a ring of either six or seven cells round the egg, below the first-mentioned ring. Below this ring is the third ring of cells, of the same number, and about the same size as the first ring. This last, or lowest, ring is close to the base of the egg. Below these cells the ribs have become so broad, that they are joined together, forming the uninterrupted basal portion of the wall of the egg. The whole surface of the egg shows a rough, irregular, cellular structure. The small rosette, about 0·03mm. in diameter, is composed of five more or less pear-shaped cells radiating from a common centre. It cannot be called neat, but is in keeping with the somewhat coarse moulding of the rest of the egg. The cells surrounding the micropyle, and running up the sides of the pit, are numerous, and of roundish shape, but they

are much wrinkled, and it is difficult to make out their contour. The basal portion of the shell of the egg is evidently very plastic when the egg is first laid, as when the egg is detached from the leaf, the base shows a replica of the leaf-surface in which the stomata of the leaf are often very clearly represented. The colour of the upper part of the egg is pale brown, with a pink tinge; the base beneath is pale grey (Sich, July 31st, 1906). The egg forms a segment of a sphere, about ·63mm. diameter at the base, and ·31mm. perpendicular height. The surface is covered with cells or pits. At the apex is the large micropylar depression, from the edge of which six rows of cells run downwards, and between which are six well-developed ribs. Each row of pits consists of three large cells of different size, the uppermost one the smallest, the lowest the largest; similarly, with their depth, the upper is the most shallow. The micropylar cell is, as a result, surrounded by six smaller cells. The sides and floors of the cells appear to be minutely dotted, also the border of the base where the six ribs terminate. The colour of the egg is whitish, but before hatching it changes slightly, and becomes somewhat tinged with flesh-colour (Gillmer).

Habits of larva.—Some eggs laid June 12th-13th, 1892, at Budafok, hatched June 20th, the larvæ were brought to England, and by the 28th the number was reduced to five; they were put on a dock, probably *Rumex crispus*, and kept in a sunny greenhouse, where three reached maturity, the first pupating on July 24th, another on the 30th, the third on the 31st. The imagines emerged between August 9th-17th of the same year (Nicholson). In the Berlin district, the larvæ leave the eggs in July and hybernate after the third moult, feeding up again in spring and becoming fullfed about the middle of June, although, sometimes, they are not fullfed until August, *e.g.*, on July 12th, 1905, several three-quarter grown larvæ were found which grew rapidly and produced the first imago, a ♀, on August 18th, 1905. In the middle of August the same year, Fassl had larvæ from eggs of the year, still very small. The larva has a snail-like crawl, and lives on the underside of the leaves of *Rumex hydrolapathum*, from which it first gnaws off the epidermis, but, as it gets larger, it eats little holes right through the leaves.* Locke notes (*Soc. Ent.*, iii., pp. 12-13) that, about the end of April, on the underside of leaves of *Rumex*, he always found the larvæ in couples, never more on one leaf, and that these always produced a ♂ and a ♀. The suggestion underlying this assertion is, one suspects, quite untenable (Gillmer). On June 8th, 1906, we received, through the kindness of Mr. Gillmer, larvæ which were variously distributed. These were nearly, or quite, fullfed, and, at rest, looked at ventrally, the head is drawn into the prothorax so as to be, on the ventral side, almost invisible, the prolegs are of a rather paler tint than the ground colour of the venter, and the still paler feet are pushed out prominently to clasp the object on which the larva rests. The body is drawn down flatly against the resting-surface, and the reddish-brown hairs form a sort

* In confinement, plants of *Rumex hydrolapathum*, *R. sanguineus*, or *R. aquaticus*, should be potted up, as the leaves of these plants, placed in water, are useless as food after one or two days. The larvæ should be sleeved or put into tightly-fitting breeding-cages, as they escape through the smallest cracks as soon as the food fails (Gillmer).

of fringe round the edge of the body. Viewed dorsally, the ground colour is of a bright yellow-green tint, with a slightly darker medio-dorsal line running the whole length of the body, more marked on the thoracic segments. The skin is covered with a large number of minute whitish points, giving rise to what appear to be bulbous-tipped hairs, whilst a large number of longer dark hairs arise from the skin-surface. The frontal portion of the body is much thicker than the hinder, rapidly increasing in height from the prothorax to the 1st and 2nd abdominal segments, then slowly decreasing its height until the anal segment makes a somewhat flattened, rounded projection compared with the preceding segment. The segmental incisions are very well exhibited. Viewed laterally, the rapid rise from the front to the 2nd abdominal, dorsally, is very conspicuous, as also the slow fall from the 2nd abdominal to the anal segment. The spiracles are conspicuous, of pale yellow or orange tint, inclining to flesh colour in those of the 7th and 8th abdominal segments, the rims darker, the inner part much paler, the larva expanding noticeably when respiration is active; the prothoracic spiracle is placed well back in the incision between the prothorax and mesothorax; all the other spiracles placed well up on the segments and rather towards the front of the segments. When crawling, the larva has a very different appearance; its small pale bone-coloured head is protruded tortoise-like, but never quite clear of the overhanging prothorax, into which it retracts its head at the least disturbance; the prothorax is, even now, the most prominent frontal part, and there is very little difference in the appearance of the thickness of the segments, the body being elongated in such a manner as to lose the extra thickness observable at the 1st and 2nd abdominal segments when at rest, and to be of almost uniform thickness from the prothoracic to the 8th abdominal, thus gaining a certain cylindrical appearance not to be observed at any other time. The prothorax exhibits a considerable depression dorsally, tending to a flattening of the segment, and thus making the anterior and posterior parts of the body somewhat alike. The colouring appears to be entirely beneath the skin, and due to the contents, the segmental incisions giving the appearance of a series of curves coming from side to side and directed forwards; the last effective incision is that between the 6th and 7th abdominal segments, the 7th, 8th, 9th and 10th abdominal segments being almost welded together, the incisions very indistinct, and the 10th segment considerably flattened. In crawling, too, there is a very distinct subspiracular flange, formed of a rather deep longitudinal depression between two outstanding upper and lower elements, the latter of which, on either side, flattens out against the resting-surface, hiding the prolegs and true legs when the larva comes to rest. It has a slow slug-like crawl, the venter kept very flat against the surface, moving very slowly, stretching out its head in an enquiring way when in doubt, and then showing up its black ocelli, the mouth-parts, which are tinged with dark brown, and the true legs of a pale bone colour, with the terminal hooks brown; at such times the 1st, 2nd, and 3rd abdominal segments, as well as the thoracic, can be held almost at right angles to the rest of the body. Just above the spiracles, when the larva is crawling, there is a depression on the 2nd-6th abdominal segments, which tends to give a still more marked appearance of uniform diameter to the larva (Tutt). Of five of these larvæ sent to Chapman, he writes (June 9th, 1906): "The larvæ are more markedly 'limaciform' than those of any other

Lycænid yet examined, differing in this direction markedly from *Rumicia phlaeas* and *Heodes virgaureae* (which are very similar to each other). The slug-like aspect comes out in several ways. In the first place, there are no dorsal ridges or flanges, which no doubt existed in earlier instars, the whole dorsum being regularly rounded from the margins all round. Secondly, the margins (marginal, or subspiracular, flanges) are closely applied to the surface on which the larva is, and the upper surface looks very flat, more so than it really is. In a large larva, 20mm. long, the width is 6mm., and the height 4·8mm. Thirdly, the colour is very uniform, a vivid green. This varies, indeed, and even the oblique lines can sometimes be supposed to be seen, but the lighter yellower-green shadings are apparently buried deep in the tissues, and the semitransparency of the larva generally adds to the slug-like aspect. The minute hairs, which are very abundant, but invisible without a lens, and the more conspicuous white dots (trumpet-hairs), only accentuate the slug resemblance, giving an idea of slime, once the slug idea is well-suggested. Further, in walking, the larva appears to glide forwards slug-fashion, and it is only by close attention that the slight vermiform (or caterpillar) movement passing along the segments can be detected. The larva, however, if one can regard it not as a slug, but as an emerald with a dewy coating, or simply as a caterpillar, is really beautiful. The fullgrown larva, before it has begun to get dull and shrunk for pupation, has a great thickness of subcutaneous transparency, that makes any attempt to fix places for the slight variation of tints it possesses almost hopeless, and, if done, really misleading." According to Newman, the larva of the British form was "fullfed in June, and then lay flat on a dock-leaf, rarely moving from place to place, and, when it did so, gliding with a slug-like motion, the legs and claspers being entirely concealed." "The head," he says, "is extremely small, and can be completely withdrawn into the prothorax. The body has the dorsal surface convex, the ventral surface flat; the divisions of the segments are distinctly marked, the posterior margin of each slightly overlapping the anterior margin of the next, and the entire caterpillar having very much the appearance of a *Chiton*. The sides are slightly dilated; the legs and claspers are seated in closely approximate pairs, nearly in a medioventral line. The colour is green, scarcely distinguishable from that of the dock leaf; there is an obscure mediodorsal stripe, slightly darker than the disc, and in all probability due to the presence of food in the alimentary canal." Of the larval habits, Sich notes (*in litt.*): "Newman was quite right when he likened this larva to the marine animal known as a *Chiton;* these creatures sit tightly pressed to the rocks, and nothing can be seen of them but their backs, divided into so many segments. This is just what the observer sees when looking at the larvæ of *C. dispar*, as they sit closely pressed against the surface of the leaves of *Rumex hydrolapathum*. If irritated, the larva presses the lateral flange, which is usually the lowest (or basal) portion of the larva visible, more tightly against the leaf at the point irritated. If the irritation be continued, the larva finally crawls quietly away, never attempting to make any counter attack. As the larva is able to move its legs and claspers without disturbing the dorsum, it seems rather to glide along than to walk. As a matter of fact, it takes very short steps with a continuous motion, and, as all the under-parts are very soft, their movement does not affect any usually visible part of the larva,

unless it is travelling at an unusual speed. It can move backwards with the greatest ease, but does not seem capable of making any very sharp turn. When walking on a smooth surface, such as glass, the larva always spins a silken thread by means of which it hangs if necessary. When gliding along, the larva will occasionally raise up the thorax, when the very small head and thoracic legs become visible. When passing a pellet, it usually raises the anal segments so that the anal claspers and the prolegs of the 6th abdominal segment come into view. In the first stadium, the larvæ live on the underside of the leaves, where they eat out small patches, consuming the lower cuticle and the parenchyma, but leaving the upper cuticle entire. They are very inactive, and are also very inconspicuous on account of their flatness, pale colour, and translucent aspect. In the third stadium they begin to eat holes right through the leaves, and, in the last stadium, they make large holes, frequently near the midrib, but though they consume the smaller veins of the leaf the large lateral veins usually stop them, and often form the margin of a hole. They feed in the gentlest manner, keeping the edge of the prothorax always close to the leaf-edge, never stretching out the head and prothorax as some larvæ do when feeding. Consequently, even when actively engaged in a meal, they never exhibit more of the head than the mouthparts, the rest being hidden under the prothorax. The spaces where they have fed never show any bold curves, but the edges all round appear as if nibbled out. These notes were made on fullgrown larvæ received on June 7th, 1906, but, on July 30th, 1906, eggs and quite newly-hatched larvæ were received from Mr. Gillmer. Some of these changed into the second instar on August 4th, and four days later they were again resting on silken platforms; they assumed the third instar on August 10th. They did not consume the cast skins. They fed vigorously for three days, and then changed from pale ochreous-yellow to brown, feeding little. On the 14th they were reddish-brown, and they left the leaves and wandered about their glass cage. These larvæ were fed entirely on *Rumex obtusifolius*. They ate no more after August 14th, and remained quiescent, though from time to time they changed their position. It seems, therefore, evident that this species hybernates in the third instar (Sich). Chapman notes that some larvæ in their third stadium ceased feeding on August 15th, 1906, and afterwards, though they moved occasionally, took no more food, becoming however, quite red-brown in tint; a silken pad is then spun on which the larva rests. One larva was observed sometimes to leave this pad, wandering for a day or two, but returning thereto, and, on September 11th, it seemed to have settled down on it for hybernation.

Larva.—*First instar:* The newly-hatched larva is yellowish-white (bone-white) before feeding, 1·5mm.-2mm. long, The dorsum has on each segment the two pairs of trapezoidal hairs (i and ii), rather long and curved backwards. There are also two rows of dark lateral tubercular dots, and three pale marginal hairs on each segment. The head is small, light brown, and retractile (Gillmer). About 3mm. long, a little longer or shorter, according to attitude; broad and short, more slender behind, when the head is retracted (as it usually is) into prothorax, the front, though rounded, is especially broad and transverse, the front margin of mesothorax being nearly as wide as any other portion of the larva; it dwindles again a little, till it rounds off on the 9th and 10th abdominal segments.

It has, in this stage, a dorsal ridge on either side (carrying tubercles i and ii), and lateral slopes. Its colour is green, at least, as soon as it has eaten anything. The prothorax carries eighteen hairs, of which six (three on each side) are on the plate, two are on the dorsum on each side, two at the margin on each side, and one nearer the front ("margin" in a Lycænid sense, *i.e.*, passing across dorsum of prothorax). Below the marginal hairs on each side is a large lenticle. The hairs are 0·2mm. (lateral-marginal) to 0·4mm. (longest central) long, finely spiculated, as are all the others; the 2nd and 3rd thoracic and 1st-6th abdominal segments carry, on each side, i and ii as very long spiculated hairs, upstanding as a crest, and curved backwards, each hair forming quite a quadrant; they are rather shorter on the hinder segments; that on i on the forward segments, measured along the curve, is about 0·8mm; ii is more slender, and is below, and a little behind, i, and about 0·5mm. long. Each hair has a distinct base, but all four are very close together, especially i and ii on the same side; tubercles i and ii across the dorsum are rather wider apart on the thorax. The lateral hairs (on marginal flange) are—four on each thoracic (2nd and 3rd) segment, three on each abdominal down to 7th, the 8th and 9th have four, say two each, but the division is not very evident; the 10th has two marginal, and three larger, hairs higher up. The marginal hairs are about 0·2mm. long; the upper ones, on the 10th abdominal, 0·5mm. or 0·6mm. The dorsal tubercles of the 7th and 8th abdominals are—i continued as in preceding segments, with ii nearly obsolete; on the 9th abdominal the two tubercles i are much wider apart, and ii quite obsolete. There are a pair of large lenticles close together on each side, apparently of the 10th, but probably the 9th, abdominal segment. Below the lateral flange are, on the thoracic segments, two small hairs at same level, and on the abdominal segments one, about halfway between flange and prolegs; a little above this, on the 3rd, 4th, 5th, and 6th abdominals, is a large lenticle. The true legs are quite pale and colourless, like the rest of the larva. There are two fine hairs at the base of the prolegs, which consist of eighteen or nineteen hooks in a circle, broken internally for a length equal to about three hooks. The claspers have an outer row of about nine hooks, and an inner set of four. There are several minute hairs near the anal claspers, but above and behind each, near anus, are two hairs, rather larger, about 0·08mm. long, of curious spiculate structure; before the ends they swell a little and give off a number of spicules, so that the last half of the hair looks like one of the compound spines of a Vanessid larva. The anal margin has a fringe of very minute hairs, probably really skin-points; behind anus, and above it, to flange, is an area covered with rather large skin-spicules, or skin-points, about 0·025mm. long. The general surface has extremely minute rounded skin-points, so small and far apart that they are like points of meeting of a network formed of fine lines that connect each with its neighbours. The structures existing on the "slopes" are exceedingly difficult to make out clearly. On the 2nd and 3rd thoracic segments there are, a little lower than halfway up, at anterior border, two extremely minute hairs, one above the other; behind these, rather in front of the middle of the segment, is a special hair structure, with another similar one, halfway between it and ii. Each is a little globular hair, hardly longer than thick, covered apparently with fine spiculation, seated on a large ring or hair-base, large, that is, in proportion to the length of the hair, and more (but still large) in accord with its thickness. These hairs are

about 0·013mm. in length; the minute hairs in front perhaps 0·004mm. The structure of these globular hairs shows them to be the first stage of the afterwards larger crop of fir-cone hairs that are, again, the same as the trumpet-hairs of the pupa. On the 1st abdominal segment, these same two round hairs occur, quite in front of the spiracular zone. There is a minute globe-hair behind spiracle, and another, microscopic, hair, midway between the spiracle and lower globe-hair; well in front of the globe-hairs, and midway between them, is a large lenticle. In this note, so far, I am in fear I have placed the upper globe-hair in front of one segment, instead of to the posterior border of the preceding. At any rate, on the following abdominal segments, on which there is an additional globe-hair in front of i, the following is the arrangement: Dividing the space between ii and the marginal hairs into five equal parts, the spiracle is one of these above margin, a large lenticle, two above spiracle, *i.e.*, halfway between i, ii and spiracle. In front, and a little below i, is a globe-hair, rather longer in outline than the others, with a minute hair at front margin of segment; just below it, behind lenticle, is another globe-hair, which is, I think, the upper one that I described (erroneously?) as at front of segment on forward segments. Another, really towards front of segment, is halfway between spiracle and larger lenticle; a very minute hair-point (iii?) between this and spiracle; a globe-hair behind spiracle. The dorsal globe-hair and the large lenticle fail on the 7th, 8th, and 9th abdominal segments, the other structures are much the same; there appear to be no globe-hairs on the 10th abdominal segment. *Second instar* (fullgrown): Length 5mm. Prothoracic plate, a very small horseshoe-shaped depression; general skin-surface covered with minute circular points; green, with yellow (deeply buried) line under dorsal ridges, and a similar one just outside it, that is, however, a little oblique on each segment. Dorsal groove darker; dorsal ridges still entitled to be so called; each segment has, laterally, five deep depressions, most marked on metathorax. Lenticles nearly colourless; a nearly mediodorsal one on front abdominal segments. Hairs short, pale, with dark spot at origin, and darker tips; those on i and ii larger, as well as the four marginal. *Third instar* (fullgrown, August 15th, 1906): 5mm. long, a little brownish-tinted, with brown dorsal ridges, accentuated by brownish hairs; a day or two ago it was more brightly and uniformly green, it is probably nearing hybernating stage. The dorsal ridges are very rounded, and are ridges morphologically rather than actually, but the larva is still of fair thickness; the larva itself is fairly arched from one lateral flange to the other, but, on an end view, the longer hairs on the lateral flange and dorsal ridge give the appearance of very flat slopes and angular dorsal and lateral ridges. The hairs on the slopes are also numerous, shorter than the dorsal ones, but, like them, brown-tinted and spiculate; from dorsal line to spiracle on either side of an abdominal segment, there are about 30 hairs, 15 or 20 to lateral flange, more or less, according to how many we count of those on the flange itself. The spiracles are small, brown, raised, thimble-like projections. The prothoracic plate is in a deep hollow, diamond-shaped, the posterior ray very long and narrow, the width about $\frac{1}{6}$ that of segment. The larva is of fairly uniform width from end to end, apart from rounded ends, *i.e.*, it has so far, none of the slug-like narrowing from thorax backwards, that marks the fullgrown

larva. No lenticles clearly made out. *Same larva* (September 11th, 1906): Since August 15th, the larva has been moving occasionally, but never eating; it has got very much darker, quite red-brown, but with an underlying green discoverable; length 4·5mm.; one sees no white points (trumpet-hairs), but the larva was not killed and mounted; it has spun a pad of silk, to which it returns after wandering for a day or two, at least, it has twice done so, and is on the pad now. This is, no doubt, the most suitable place for hybernating within its reach, but does not please it; it is on the lid of a tin box (Chapman). *Final (? Fourth) instar* (June 9th, 1906): The smallest larva in this instar is 11·5mm. long, 3·4mm. wide at 1st abdominal, and nearly 3mm. high, of which 1mm. is below the lateral flange. The head is green, faintly tinted with ochreous; eye-spots very black, and jaw and margin of labrum brown; the colour of the body is a fresh bright green, modified by the transparency of the tissues, and the surface-covering of white points and ochreous (hardly brownish) hairs. The white points are about 30, and the hairs about 50, to a square millimetre of surface on the dorsum; the hairs are tinted brownish-ochreous, darker at their extremities, and rough rather than spiculated, about 0·3mm. on the lateral flange where they are long, on the dorsum, not half that length. The white points are approximately globes, attached to the skin by a small portion of their surface (no pedicel), and with a roughened (hardly spiculated) surface—or perhaps an extremely minute spiculation. They remind one a good deal of the ova of *Micropteryx*. The skin-surface is closely set with very minute raised (uncoloured) points. The dorsal ridges are represented by a few longer hairs on the posterior margins of the segments. The prothorax carries a plate, which is very long from back to front, and extremely narrow, widest in middle, going to a point at front and rear; it is about 1mm. long, 0·6mm. wide, faintly ochreous, with a median green suture; the posterior branches carry several lenticles. Lenticles also occur elsewhere, but very sparsely, except on the dorsum of each segment, in the neighbourhood of a depression that is mediodorsal, and part of a subsegmental incision dividing the segments into a rather smaller front and large back subsegment. The lenticles become more numerous posteriorly, and the 9th and 10th abdominal segments (anal plate?) are well supplied with them. The prolegs have the usual central white extensile pad and two hook-bearing pads; each of these carries 13 to 20 hooks, in two rows, so far irregularly placed that even a third or fourth row might be imagined; there are also 14 or 15 small hooks on outside margin. The anal claspers have the same structure, with 35 hooks on forward outer pad, 20 to 25 on posterior inner. The teeth of the jaws are very long and sharp. The true legs are green, except last joint which is tinted, and claw dark. The undersurface is pale (white or colourless), except that the deeper-lying green shines through, and plicated, and covered with white points and hairs as freely as the uppersurface. This larva carries its width from mesothorax, with very little narrowing, to the 7th abdominal segment, and in so far is less slug-like than the nicely tapering full-grown larva. The prothorax has the plate in a pit, which, owing to its diamond-shape, gives a deep longitudinal sulcus, and, from the outer angles, a sulcus, reaching outward and backward to above the spiracle, marks out a swollen lappet on each side of the plate; a less marked sulcus reaches forward from the spiracle; this one is continuous with the upper sulcus, marking off the lateral flange from the "slope," and

is rather marked all round in this larva. In most points of view, this flange looks paler than the rest of the larva, merely, however, because its marginal character prevents it having a background of the internal viscera of the larva. The prothoracic spiracle is in the sulcus, the others are well above it, that of the 7th abdominal a little more dorsal than the others, but the 7th and 8th are not at all markedly dorsal as in some Lycænid larvæ. The 7th and 8th abdominal spiracles are largest, forming light brown rings, the largest about 0·08mm. in diameter. In a dorsal view, the margin (flange) is fairly continuous, each segment only a little rounded, and incisions narrow. On the dorsum (side view) each segment is similarly, only slightly, rounded, giving a fairly continuous dorsal line, highest at the 3rd thoracic or 1st abdominal, and fairly level to the 6th and 7th abdominals, falling in this length very little. *Nearly fullgrown*: A last stage larva, nearly fullfed, is 20mm. long, widest at the 2nd abdominal segment, 6mm., narrowing thence pretty regularly in each direction; 3·5mm. across at posterior border of prothorax, and the same at the middle of the 8th abdominal. An examination of this larva raises a doubt, or more than a doubt, as to whether the smaller larva just described is not in same instar as this one, the close setting of hairs and white points making it practically impossible that it can grow and separate these as in this specimen, and yet have room for another moult. This one has only about 18 or 20 white points to a square millimetre, and they are much more easily seen, each a small globe, covered with a very close setting of sharp points, which, nevertheless, have a soft curved look. No trace of dorsal glands. This large larva has quite got rid of the sulcus above the lateral flange; the surface is smoothly continuous across dorsum, and there is only the slightest convexity to each segment, either along the dorsal or lateral line (Chapman). *Final instar* (fullgrown): Length at rest 21mm., outstretched 25mm., width 6·5mm., height 5mm. Colour, pale yellowish-green, dorsal vessel and lateral flange darker. Spiracles light brown, ringed with dark brown. Pit on prothorax grey, central line of pit bluish-grey. Head pearly-grey. Ocelli black. Jaws brown with a pink tinge. Thoracic legs grey, tipped with a brown hook. Ventral and anal claspers pale green. The venter is blue-grey, and unspotted, contrasting strongly with the green colour of the rest of the larva. The whole surface of the larva, except the venter, is thickly sprinkled with white dots, and is, besides, covered with very short down, mostly whitish, but brown on the thorax, especially on the prothorax and round the edge of the flange, where it assumes an almost red tinge. This gives the larva a soft velvet-like appearance. Lateral view: The head is exceedingly small, and capable of being entirely withdrawn into the prothorax, which hangs over it like the eaves of a thatched roof. The lateral flange is very heavy, and is continuous all round the larva. Thus the dorsum of the larva combined with the flange forms, as it were, a complete roof, its eaves being formed by the overhanging prothorax, the anal flap, and the lateral flange. When at rest the head, legs, ventral and anal claspers, are absolutely hidden under the roof, for its eaves come closely down to the surface on which the larva lies. The incisions of the segments, between the metathorax and 1st abdominal segment, and between the other abdominal segments, up to the 7th, are well marked on the dorsum, but those of the thorax, and the 8th, 9th, and 10th abdominal seg-

ments are very ill-defined. Subsegmental divisions are not visible unless indicated by a line, sometimes noticeable on the subdorsal area, which divides the segment into two portions. In certain lights this larva has a most singular aspect; it appears exactly as though an ordinary-shaped cylindrical larva, with two pale oblique stripes in the subdorsal area of the well-marked abdominal segments, has crawled into a translucent velvety envelope, the envelope being more visible at its lateral expansion, where the larva did not quite fill it out. Ventral view: It is only when the larva is turned over on its back that the head and legs can be properly seen. The first thing to strike the eye is the leaden colour of the venter itself, as seen between the legs and the claspers. The head is exceedingly small, being only about 2mm. wide, and almost entirely enveloped by the prothorax, which surrounds it like a very much inflated pneumatic tyre. The head is notched on the crown, but not deeply, the clypeus distinct, and the epistoma large. Antennæ rather large, ocelli very conspicuous from their blackness, the rest of the head being pearly-grey, the epistoma is, however, browner grey and the jaws light brown. The head is smooth except a few hairs below the mouth. Below the head is a pale ochreous spot, possibly an indication of the chin-gland. The skin, where the head joins the body, is blue-green. The part of the prothorax in which the head is sunk has no long hairs, but is covered with a short pile. Thoracic legs very short and set up on large cushions. The 1st and 2nd abdominal segments have anteriorly two deep pits, one on either side of the medioventral line, and posteriorly two deep transverse furrows. The ventral claspers are also short, and placed on cushions, but these are not so large as those of the thoracic legs. On the 7th abdominal segment are two pits posteriorly, and a dark triangle on the 8th abdominal; the 9th is divided by a dark medioventral band with a fine white line of muscle on either side anteriorly, the 10th carries the anal claspers, which, as before stated, are quite hidden by the heavy dorsal flap (Sich).

Foodplants.—*Rumex hydrolapathum*, *R. obtusifolius* (Sich), *R. sanguineus*, *R. aquaticus* (Gillmer), ? *Rumex crispus* (Nicholson), [*Rumex acetosa* (Wocke), *Polygonum bistorta* (Heyne).] Some larvæ, in the last stadium, came to hand on June 9th, 1906. These fed up fairly well on *Rumex hydrolapathum* and *R. obtusifolius*. I certainly believe they preferred the former, but would eat the latter when the former was stale. They would not touch the leaves of *Rumex acetosa*, with which I also sometimes supplied them (Sich).

Pupation.—The first of the larvæ noticed above spun up for pupation June 16th, 1906. A day previously I had noticed that it was no longer feeding, and I placed it in a cage with earth, stem and leaf of dock, and a piece of pasteboard bent at right-angles and turned over at the top. The whole of it was covered with muslin; after wandering about for some time, the larva finally settled down on the muslin cover, and spun its platform and girdle. Here it rested till the afternoon of June 18th, when, by 6.30 p.m., it had changed to a pupa. After spinning up, the larva loses some of its flatness, becoming more cylindrical, but, with the exception of turning slightly darker, it does not change from its lively green colour. This seems to suggest that, in freedom, pupation usually takes place on the leaves of the foodplant. The girdle is composed of about six strands,

and then are not joined together as one. They pass over the centre of the metathorax of the larva obliquely down the side of the first abdominal, and are fastened below the second abdominal segment. In the pupa the girdle passes between the first and second abdominal segments. A second larva, treated in the same way, also chose the muslin cover to spin on, and was fixed up by 5 p.m. on June 20th, becoming a pupa between 3 p.m. and 4 p.m. on June 21st. On June 30th, at 9.45 a.m., I saw that the first mentioned pupa had yielded a female imago which had evidently just emerged. She crawled a little way from the pupa-case along the muslin, and then remained quite still. The wings, which had just commenced to expand when I first saw her, had reached their full size in eight minutes, though they were then still limp. The pupal stage thus lasted nearly twelve days. The second pupa remained in that stage for fourteen days, and the imago, also a female, emerged between 6 p.m. and 9 p.m. on July 5th. This appears rather a late hour for a day-flying species to emerge (Sich). Two pupæ examined: One is loose, the other has formed a puparium from a portion of a leaf, now somewhat shrivelled. It enfolds the ventral area, and a portion of the dorsal, on one side only. A silk net, or loose pad, has been spun on the leaf, and this forms the attachment for the anal armature, composed of numerous, short mushroom-topped bristles, set at varied angles. The anal end, which is comparatively smooth, has a broken ring of these hairs surrounding a smooth depressed area; they occupy the extreme end of the anal segment, which has a ventral aspect, and are continued along the sides of the ventral portions of the 8th and 9th abdominal segments, but are absent from the medioventral area of the 8th abdominal segment. The anal slit and sexual organs are very obscure. I fancy, from the traces one can make out of the latter, that the smaller loose pupa that I am now examining is a male. With regard to the puparium, some silk has been used to draw the leaf to the sides of the pupa and curl it upwards, making a saucer-like hollow for the ventral area to occupy, no doubt the curling has been somewhat exaggerated by subsequent drying. Some of the threads used have been caught under the rays of the star-like processes (hair-developments), on the lateral area, and are not, so far as I can ascertain, continued across the dorsal area, but are doubled back and reattached to the leaf. Others are continued and join up to form a band or girth; there is also a single thread which crosses separately to the main girth. Neither of these supports lies in the dorsal groove or waist, the main and upper one crossing at the middle of the 2nd abdominal segment, and the single thread at the junction of the 3rd and 4th abdominal segments, the waist, as usual, being at the junction of the metathorax with the 1st abdominal. So far as this particular pupa is concerned, the position seems to be that the cocoon-making habit of its ancestors is represented by the few silk threads used, and that a definite girdle has not yet been fully evolved. The pupa spun up is, judging by its size, likely to be a female, the loose one, as already mentioned, a male (Bacot). The larvæ spin up with the head downwards, and, in this position, with a silken band round the middle of the body, change to pupæ, those I had from July 24th-31st, 1892 (Nicholson). The notes of Sich and Nicholson suggest that a fairly satisfactory girth is constructed [see also *posteà*, p. 450]. Bartel notes that

pupation takes place in the Berlin district from the middle of June onwards.

Newly-formed pupa (rutilus).—When first the larval skin is thrown off, the pupa is very pale in colour. The darkest part is the dorsal vessel, which, in the pupa I watched, beat regularly 60 times a minute. This action can only be observed for a very short time after the larval skin has been cast. Head not visible from this point of view. Prothorax pale translucent greenish-grey, the marks of the spiracles visible as elongated ochreous spots (dorsal vessel not visible on prothorax). Meso- and metathorax and wing-cases of the same colour as prothorax; the dorsal vessel dark grey-green. The abdomen pale yellow in the dorsal and subdorsal areas, with brownish blotches on the 3rd, 4th, and 5th abdominal segments in the subdorsal area. On the lower border of this area there are dark spots on the 3rd, 4th, and 5th abdominal segments, and below these are pale circular spots on the 2nd, 3rd, 4th, 5th, and 6th abdominal segments. Some way lower down are the narrow white spiracles. The spiracular area is greenish-grey, dotted with white, and is bordered dorsally by a serrated line. The 8th and 9th abdominal segments are invaded by the dorsal yellow colour, the dark dorsal vessel being here scarcely discernible. After about an hour, a faint line appears down the centre, and moss-like marblings come on the subdorsal region of the prothorax. The inner and outer margins of the wing-cases become darker green. A second pale spot appears below, and partly behind the pale spots already mentioned as occurring on the abdominal segments. Beneath, the pupa is greenish-grey, but the prothorax and the segments beyond the wings are ochreous-grey. In three to four hours after the larval skin is cast the ground colour of the pupa has changed from green to brown, and all the darker markings have become still darker (Sich).

Pupa [From pupal-shells of British *C. dispar*].—These strike one as being very large, notwithstanding the considerable size of the butterfly. The pupæ of all the Lycænids seem rather large in relation to the size of the body of the imago, but the large relative spread of the wings no doubt requires a supply of fluid for their expansion, normal in proportion to the wings, but large in proportion to the size of the body of the insect. The pupa is 16·0mm. long, 6·5mm. broad, and 6·0mm. high at the 8th abdominal segment, where it is most robust. At the 1st abdominal segment it is only about 5·0mm. wide or high, but dehiscence makes accuracy here only comparative, and forwards impossible; but the abdomen is certainly more full, more nearly spherical, than in the pupa of *R. phlaeas*; the total length of the abdomen (parallel to venter) is 8·0mm. (obliquely from front of 1st abdominal to cremaster, 9·0mm.). The girth varies very much; in one it is a fairly compact strand, but obviously of several threads lying between the 1st and 2nd abdominal segments. In others the separate threads are more or less scattered anywhere between the mesothorax and 3rd abdominal segment. The colour of the shells differs much from that of those of *R. phlaeas*; it is a warm ochreous and brown, whilst in *R. phlaeas* it is a yellowish-grey and black. There is nowhere any black, simply the two tones of pale ochreous and pale brown, differing a little in intensity in different specimens; only on the prothorax is the tone a little paler (or whiter). On all is a series of oblique pale bands (oblique downwards, or ventrad, and backwards) on the abdominal segments, but lost on the hinder ones, each band

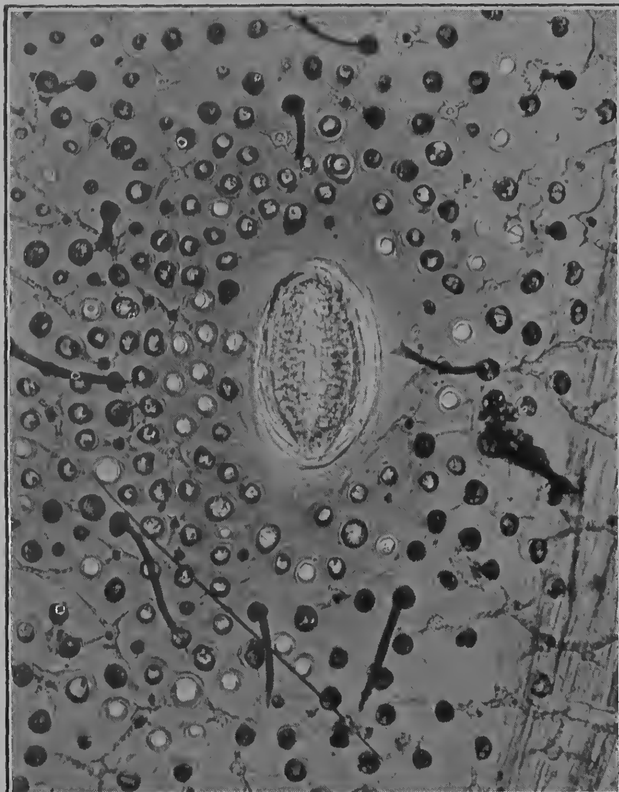


Photo. F. N. Clark.

1. Spiracle and surrounding area of pupa of Chrysophanus dispar (×100).

Photo. F. N. Clark.

2. Nearly one-fourth of the cremastral area of pupa of Chrysophanus dispar (×100).

about 0·5mm. broad, and 1mm. from middle line at anterior border of segment; there is also a narrow, darker, dorsal line. The space above the oblique lines is of the same colour as that below in dark pupæ, paler in the pale pupæ. Below the oblique bands are two pale spots, also obliquely placed; these are nearly white in the palest pupæ, but of the same colour as the oblique bands in the darker. The dark dorsal line is continued on the thorax, which presents dorsally (on all the segments) a paler tinting with darker spots. The two tints are the same as those of the abdomen, but the pale being the ground colour, the thorax, except in pale specimens, looks lighter tinted than the abdomen. The wings are pale, without markings, except the lighter lines of the neuration, ending in a broad band outside "Poulton's line," which is well-marked, and like the other neurational lines. The spiracles are pale, looking like a third to the two spots above. The prothoracic spiracle-cover is a narrow slip about 0·7mm. long, attached to the mesothorax, and beautifully ornamented with a velvety coating of very fine hairs, or spicules, each of which appears to be terminally spiculated, but they are so dense that a close view of one is not obtainable. The antennæ extend to the end of the wings, 11mm. from front (10mm. from base of maxillæ). The maxillæ disappear beneath them at 6mm. from their base (4mm. from the end of the antennæ). The second legs are a millimetre shorter, and the first legs end at another millimetre nearer the head. The first legs are very large and broad basally, and shut out the second legs from the eyes. The labrum and jaws are small triangular portions, and the labium is unrepresented. In dehiscence the thorax slits down the back, and the head, appendages, and antennæ in one piece, separate forwards more or less from the thorax and wings. There is a strong tendency for the thorax and wings to separate from the 1st and 2nd abdominal segments, and even the 3rd, and the prothoracic and metathoracic pieces retain their places by no very solid attachments. The surface has everywhere (except on the appendages) a large number of "umbrella-hairs," or "trumpet-hairs," least abundant on the dorsum of the abdomen, more plentiful in the spiracular region (pl. xii., fig. 1), very numerous indeed on the prothorax. A few somewhat ordinary hairs occur also on the prothorax and near the abdominal spiracles, regions that also afford many blank circles, that are of the same nature as the larval lenticles. The disc of the prothorax is so occupied by lenticles and trumpet- (or umbrella-) hairs, that only its margins show the sculpturing of points and ribs that prevail elsewhere. On the appendages are not only no hairs or lenticles, but none of the points either; but the ribs form a most elaborate and beautiful reticulation of sinuous lines, splendidly developed on the wings, less so on the maxillæ. On the dorsa of the abdominal segments, the lines of fine ribbing are straight, and have points at each angle of intersection; they form a set of irregular polygons of various sizes. The points are rather wider than the ribs they are on, and seem to be elevations with a rounded surface and an impressed stellate sculpture on the summit. Neither hairs, trumpet-hairs, or lenticles, take the place of these or occur on the ribs; the hairs and these points seem to be mutually exclusive. In the spiracular region, where they are all very crowded together, a trumpet-hair or a lenticle will frequently be seen on the line of a rib, and apparently on it, but closer examination shows that the rib dies out

before reaching it. Examination of pl. xi., fig. 2, shows the trumpet-hairs as manifested by this pupa (×200 diameters). If it be compared with the similar one of *R. phlaeas* (pl. x., figs. 1-2), the resemblances will be seen to be very close, and differing a good deal from the somewhat allied ones of *Heodes virgaureae* (pl. xi., fig. 1), and very much from the somewhat remarkable form they assume in *Loweia amphidamas* (pl. xiv). It will be noted that the pupal surface is, in both cases (*C. dispar* and *R. phlaeas*), and, indeed, in the others, marked out into small polygonal areas by raised ribs, which have, at their junctions, rounded tubercles, of which the darker interior shows some indication of radial division into sections. This arrangement is probably identical with that in *Thestor ballus* (pl. xv., figs. 1-2), where the cells are much smaller and the ribs and tubercles larger, and the latter with more obvious detailed structure. One observes here also that the ribs joining the tubercles, in some cases, do not, in fact, always do so, but lose themselves by spreading out on the flat areas, often fairly close together, but with the aspect of preferring to take a slightly different direction and finish rather than meet their neighbours. This phase is well illustrated in *T. ballus* (pl. xv). In some areas, all the tubercles are linked up to their neighbours and there are no loose ends; in others, the ribs merely continue the hexagonal structure of the tubercles and alternate with neighbouring ones instead of meeting them. These two phases are most pronounced on areas somewhat apart, nevertheless they are shown in pl. xv., fig. 2. The upper and right hand sides show the tubercles linked together, whilst the alternate arrangement is seen in several tubercles towards the middle of the lower margin. It has been suggested (*Ent. Rec.*, xviii., p. 145) that these tubercles represent skin-hairs, but I believe, now, that this is a very doubtful suggestion, since, as a fact, they never by any chance carry hairs. The few very minute hairs that occur on the pupa of *T. ballus* always occupy the clear interspaces, and are, therefore, the representatives of the trumpet-hairs of the Chrysophanids. It is especially to be observed in both *R. phlaeas* and *C. dispar* that the trumpet-hairs arise from bases in the interspaces, and never from the ribs or their associated tubercles. Plate xi., fig. 2, shows the ribs and tubercles strong and clear in places, fading out in others; the trumpet-hairs are, perhaps, a shade smaller than those of *R. phlaeas*, 0·05mm. in height, 0·01mm. wide at base, and 0·03mm. to 0·06mm. wide at top in different specimens. They appear to be colourless or glassy in material, any dark lines they show being due to refraction. At the top and the bottom of pl. xi., fig. 2, are two circles that may be "lenticles," but are more probably the bases of trumpet-hairs that have been broken off. One is rather annoyed in a field of view to find one or more hairs obviously broken away, and sometimes the whole field cleared, but, looking at their frail and evanescent appearance, one after all wonders how, in the accidents that befall pupæ (alive or dead), at the hands of the collector even, any proportion at all of the hairs happens to remain. In the photograph (pl. xii., fig. 1) the spiracle of the left side of the 6th abdominal segment of the pupa of *C. dispar* is shown, with its surrounding territory (×100). We have here a very definite difference between the sculpture and hairs, otherwise so much alike of *Rumicia phlaeas* and *Chrysophanus dispar*. In *R. phlaeas* there appear to be no hairs except the trumpet-hairs, whilst in *C. dispar* we have long hairs (0·08mm. to 0·17mm.) of more ordinary

*Del. L. M. Chapman.*

Fig. 1.—Trumpet-hairs on Pupa of Heodes virgaureæ var. miegii × 200.

*Photo. F. N. Clark.*

Fig. 2.—Trumpet-hairs on pupa of Chrysophanus dispar × 200.

PLATE XIV.

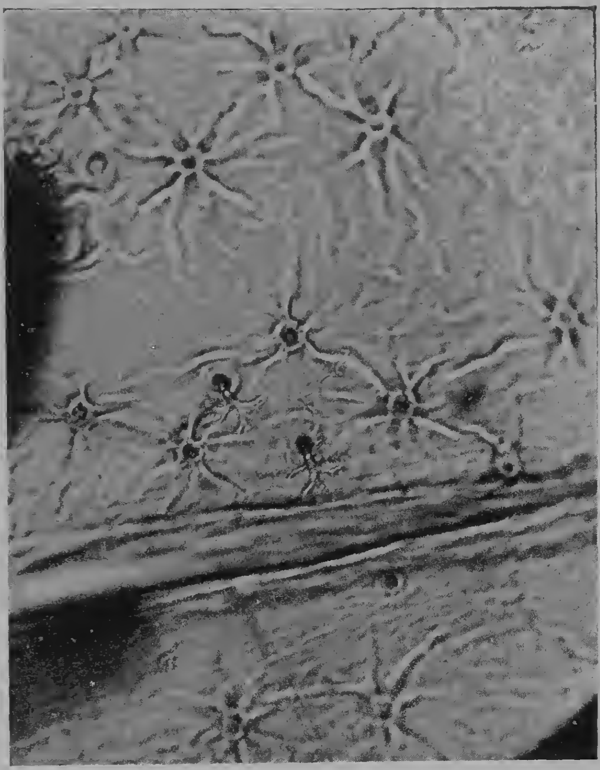
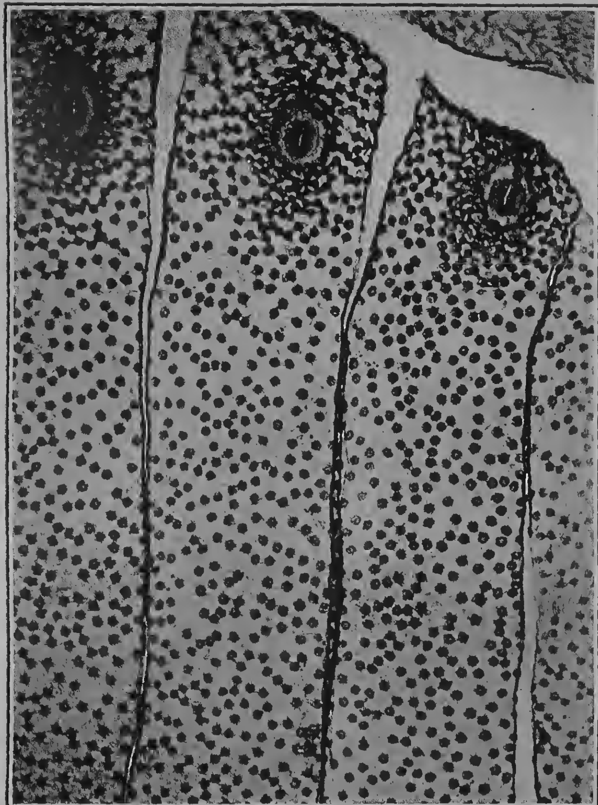


*Photo. F. Noad Clark.*

PUPAL SKIN AND HAIRS OF LOWEIA AMPHIDAMAS × 200.

*Natural History of British Butterflies*, Dec., 1906.



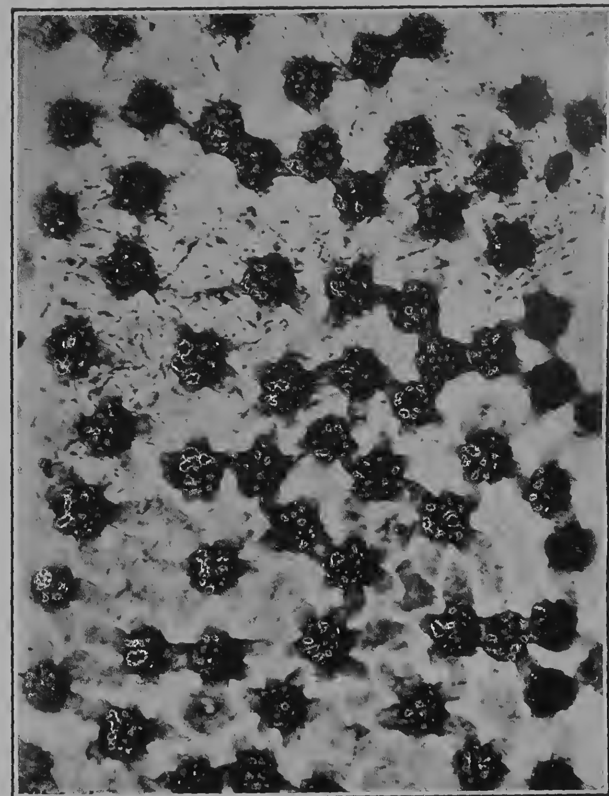


Photo. F. Noad Clark.

FIG. 1.—PUPAL SKIN OF THESTOR BALLUS × 20.

FIG. 2.—PUPAL SKIN OF THESTOR BALHUS × 100.

type. These occur, however, only in the circumspiracular region, including the prothorax. Each hair is a little swollen in its last third, and, from the surface of this portion, arises a number of fine spiculæ, generally standing out at right-angles to the axis of the hair, producing a very different appearance from the spiculated hair so often met with. Amongst these hairs in the photograph (pl. xii., fig. 1) is one, *viz.*, that pointing, and with its end close, to the side of the spiracle, which, instead of terminating in a sharp point, has an oblique flat end, armed with spiculæ, clearly a hair that was not quite sure it ought not to have been a trumpet-hair. Several trumpet-hairs may also be seen in the photograph. The great mass of the circles unprovided with hairs are no doubt lenticles—some may be hair-bases where the hairs have been lost. Unfortunately, in the preparation, a majority of them have succeeded in retaining an air bubble, which makes them look black in the photograph. Nearly all those, however, that are not so obscured, possess a membrane or diaphragm of minutely dotted structure, like that usually met with in lenticles. The spiracle is of elaborate structure. It may be described as an oval tube nearly as long as it is wide, with the opening it presents diminished to a central slit by membranous outgrowths on the sides, nearly meeting in the middle. Each of these seems to be a pillar of transparent material expanded at its top into a flat plate. This differs much, if not in essential structure, certainly in appearance, from that of *R. phlaeas* (in which each spiracle has an outer projecting mass, of a *chevaux de frise* character), looking as though the pillars (in *C. dispar*) did not end within the spiracle, but, bending, emerged from the middle of the spiracle, and then, bending outwards in rounded batons closely set together, of a length rather greater than half the width of the spiracle, formed a sort of outer basket-shaped structure, but of such transparent material that it is difficult to decide whether it does consist of a number of separate batons, or whether the lines are only grooves on a continuous structure. The pupæ of *C. dispar* and of *R. phlaeas* present certain spiculated areas that very strongly suggest the spiculæ seen on Nepticulid pupæ and those of other lower micro-lepidoptera, which are the forerunners and primary forms of the rows of spines so well-developed on the pupæ of Tortricids and various other of the higher micro-lepidoptera. They agree with these micro-spiculæ in their distribution and in their attitude, *i.e.*, directed backwards (not dorsally but terminally). They are very small, but are more or less similarly arranged in rows. On the forward abdominal segments they are dorsal only. On the 7th and 8th they are also lateral, and on the 9th and 10th they occur ventrally and over wider areas. In both species, they occur as an anterior band along the anterior borders of the segments, and a posterior close to the hindmargin. The anterior row occurs in *R. phlaeas* on all segments 2-9, the posterior on 1, 3, 4, 5, 7, and 8. The posterior row on the 2nd abdominal segment is quite forward of the posterior margin, without being quite in the middle of the segment. This is also the case in *C. dispar*, in which the anterior row exists on 2, 6, 7, 8, and 9, and the posterior on 3, 4, 5, 6, 7, and 8. Plate xii., fig. 2, represents a portion of the cremaster of *C. dispar*. The cremaster consists of a very large number of hairs about 0·14mm. long, with a double anchor-like hook, or pair of hooks, at the free end. Just above these, on the right, is seen an area of skin-points, which are very similar to, and

continuous in distribution with, those already referred to as forming the micro-like rows. These rows of spicules have no apparent relation with any larval structures. The full-grown larva of *R. phlaeas* has spiculated hairs, but no skin-points, the skin-surface being divided into a mesh of hexagonal cells by a fine network of lines. It seems difficult to avoid looking for some relationship with some micro-ancestor to account for them, and yet it is almost more difficult to explain their survival, since they must have been useless for their original functions for many ages. It is, however, no easier to suggest any other origin for them, or to imagine what useful functions they can now perform. To return to the cremastral area and its hooks, I find it impossible to satisfy myself as to the limits of the 9th and 10th abdominal segments. On the ventral line, the 7th segment is clear enough, but the 8th is so contracted and fused with the 9th, that even its limits are doubtful. Except on the ventral line, the posterior margin of the 8th is definite enough. Within the circle it encloses, to take the specimen of *C. dispar* before us, and specimens of *R. phlaeas* agree with it, we find first, in the dorsal half, an area much like the rest of the pupa, with buttons, ribs, and trumpet-hairs, but with a small central area smooth, except for some lines radiating from its centre. This has all the appearance of a scar, not unlike that of the horn in Sphingids, but whether of some injury or normal might be doubtful, were it not that other specimens present a very similar appearance. Turning to the ventral half of the area, we find it more delicate and transparent, and divided across the middle by a suture, which does not, however, reach either side. The whole of the area is armed with the cremastral hooks, except a portion in the middle line, slightly behind the suture noted, but chiefly between it and the front of the segment. In the middle of this clear area are two projecting points side by side, and, running forwards from between them, two fine ridges with a groove between, ending in front by widening out into a rounded lappet, with a surface of extremely fine spiculations. This appears to be at a different level from the portion of segment that seems to overlap it from either side and carries the hooks, and one might suppose this to be the 9th and the hooks on the 10th, but those immediately behind the surface are continuous, without intervening suture. *Living pupa* (changed June 9th, 1906) (*rutilus*): At first, pale greyish-green, but soon develops darker markings. There persists, on the 2nd, 3rd, 4th, and 5th abdominal segments, a yellow-greenish series of oblique marks, the "oblique" lines, which are hardly visible in the larva. The pale coloration also persists beneath. The chief darker markings at present (6 to 12 (?) hours after pupation) are a dark olive (thin black over green) mediodorsal line the whole length of dorsum; a number of dark (black) spots, abundant on sides of mesothoracic dorsum (which is pale between these and dorsal line), also abundant on metathorax, but smaller and less numerous on prothorax. There is a dark shade down the wing-base from prothorax to wing-spine, and thence down the wing between nervures 1*a* and 1*b*. The wing also has a dark shade along the inner margin. The abdomen is pale on each side of the dorsal line on the 1st and 2nd abdominal segments, the "oblique" line here stretching inwards on the following segments 3, 4, 5, and indeed 6, 7, 8, and 9; the area between the dorsal and oblique lines is olive, with a faint rufous tint. Outside the oblique lines it is deep olive, with two

pale spots placed obliquely parallel to oblique lines, and then the white spiracle, about which is a number of small pale spots. The prothoracic spiracle-cover is white, and placed well back from the antennæ (Chapman). *Size:* ♂. Length, 12mm.; from head to end of antenna-cases, 9mm. Greatest diameter, at the 4th abdominal in lateral plane, between 6mm. and 7mm.; at the mesothorax about 5mm., and about the same height, *i.e.*, the dorso-ventral plane. The length of the larger pupa, ♀, is 15mm., and bulky in proportion. It is of the usual Lycænid pattern, but the thorax, in addition to being very much smaller than the globular abdomen, does not bulge conspicuously as is the case with some Theclids (*Strymon w-album*). The waist is dorsal only, and not very deep. Dorsally the length of each of the 2nd to 7th abdominal segments is about equal; the 1st abdominal segment is small; the mesothorax, as usual, very large; the metathorax quite small; the prothorax rather large and neatly rounded off in front, having no suggestion of the over-hanging cowl-like appearance of the Theclids. It is essentially a more primitive-looking pupa than those of the last-named group. The ventral aspect of the abdominal segments is pale, and the latter have the fragile look which is characteristic of intersegmental membrane, giving a suggestion of the possibility of movement which is, however, not justified on dehiscence, save, possibly, to a very slight extent between the 4th and 5th abdominal segments. The ventral area is much flattened, a medioventral line would be almost level, in fact it appears so in comparison with the rounded contours of the pupa as a whole. The spiracles are large and conspicuous, set in a slight hollow, and a trifle raised so that their level at the rim is almost flush with the rest of the surface. The slit-like opening is pale-coloured. The area surrounding the spiracle is studded with the trumpet-topped hairs which have a star-like appearance under a low magnification, elsewhere, the most conspicuous surface-sculpturing consists of a network of fine dark coloured veining; on the dorsal area the intersection of the veins tends to become conspicuous, forming star-like processes in low relief. In addition to the trumpet-hairs are numerous small raised rings, suggestive of lenticular origin, but very small. The surface is, as a whole, smooth and somewhat shiny, but not polished. The colour is brown, darkening, as usual, on the dorsal and thoracic areas, pale ventrally, a dark mediodorsal stripe running from head to anus. Above the whitish spiracles are two very pale, almost white, spots, set obliquely, the lower suggesting that it is composed of two spots joined. This origin is evident from the 2nd to the 7th abdominals, but on the 1st and 8th abdominals only one small very faint spot is to be seen. Above these spots is a series of faint, pale-coloured stripes, somewhat curved and set so as to suggest an oblique series; they are distinct from the 1st to 6th abdominals. Beneath the spiracles is one small pale spot on the 4th, 5th, 6th, and 7th abdominal segments. The anus, especially ventrally, is quite pale. The wing-cases are pale brown towards the base, with darker bands between the veins towards the margins of the wings. The eyes have already darkened, as have also the leg-, antenna-, and haustellum-cases to a less extent; the darkened portion of the antenna not reaching quite to the tips of the cases; these are flush with the wings and appear to encroach on the 5th abdominal segment, but it is difficult to say if this is more than apparent, as the segments are extremely short ventrally, and seemingly,

but not in reality, composed of folds of intersegmental membrane. The haustellum-case and leg-cases extend about two-thirds of the length of the antenna (Bacot, June 24th, 1906). The swollen abdomen of the pupa and the markings upon it certainly have some resemblance to the abdomen of a large spider (Sich).

Pupal colour changes.—♀ Pupa (*five days old*): The eyes show darkly. *Six days old:* Eyes and legs dark-grey, wings with an ochreous tint, prothorax still very pale, meso- and metathorax darker grey. *Seven days old:* Eyes almost black. Prothorax still pale, ground colour elsewhere ochreous-brown. Limbs very dark; wings deep ochreous, with the borders dark. The oblique stripes and pale spots of the abdomen still conspicuous. *Seven-and-half days old:* Wings becoming coppery, black wing-spots visible. *Eight days old:* Ground colour very dark, almost black prothorax, 1st abdominal and the stripes and spots on the abdomen grey. The 9th and 10th segments ochreous-grey, with a black quadrilateral spot in the centre. Spiracles still silvery. In the spiracular region the dark abdomen appears grey on account of the numerous white trumpet-hairs here situated. Wings red, with black outer-marginal band and spots. Antennæ black, ringed finely with pale grey. On the ninth day the butterfly emerged (Sich).

Time of appearance.—The species is hardly to be called partially double-brooded in its localities in Central Europe, for the taking of even an occasional autumnal specimen is a rare occurrence in the more northern parts of its area. In Britain, it seems to have occurred as a single-brooded species, appearing between the end of June and the commencement of August, the earliest date recorded in the diaries of J. C. Dale being June 25th, 1826. The same observer notes also July 3rd-5th, 1833, July 19th, 1827, August 1819, and August 4th, 1821. Speechly took imagines in August 1818, whilst Dale further notes larvæ as taken on June 6th, 1841, June 25th, 1826, and July 24th, 1827, and pupæ July 25th, 1827. Larvæ were also taken June 7th, 1841, at Whittlesea Mere, by Doubleday (*Ent.*, xxviii., p. 42). Haworth gives July as the time of appearance of the imago, so also do Stephens and other British authors, and Bond particularly states that the species was not, in his opinion, double-brooded in this country, and that the imago made its appearance in July and August from larvæ found feeding on *Rumex hydrolapathum* in June. Gillmer says that, in nature, in the Berlin district, the insect is single-brooded, although, in confinement, an occasional specimen of a second-brood may be reared, *e.g.*, Fassl bred a ♀ August 18th, 1905, but Gillmer doubts whether even this was not a late example from a hybernated larva, as the same year larvæ three-quarters grown were taken (with this) by Fassl on July 12th, whilst larvæ of the year were still very tiny on August 9th. Dadd notes it as being in fine condition in the beginning of July, 1904, at Spandau. It may be that a few feed up rapidly in warm seasons, as there is no question of its double-broodedness in the south-east and south-west of Europe, *e.g.*, it is recorded as occurring in the Bordeaux marshes in May, June, and again in August and September (Brown), whilst Godart found it as early as June 15th, 1821, near Petit-Gentilly. Verity notes it at Modena, September 6th, 1900, evidently a second brood. Rehfous captured examples August 8th-23rd, 1905, at Glanon-sur-Saône, of small size, and possibly, therefore, of the second-brood. Norris found the imagines abundant from September 12th-October 1st, 1891, at Lago Massciuccoli near Viareggio, the specimens being in good condition on

the latter date, no doubt a second-brood. The same observer also notes the capture of imagines on July 29th, 1892, on the marshes round the great springs of Beinette in the Certosa di Pesio district, also, one suspects, a second brood. Mrs. Nicholl found the specimens of the first brood going over in the Save Valley on June 18th, 1898, at Slavisch Brod, and the second brood was taken during the last few days in July at Serajevo, not more than half as large as those taken in the Save Valley a month or six weeks earlier. She also took the species on June 8th, 1899, in the Struma Valley, in Bulgaria, and, again, a series in the marshy Save Valley in Bosnia, towards the end of June, 1901, evidently also of the first brood, but she says (*Ent. Rec.*, xi., p. 4) that the species may be taken pretty nearly all through the summer at various dates, according to the elevation, in every wet valley in North Bosnia, up to a height of about 2000 feet (or more), whilst the second brood appears in the lowlands almost before the first brood is over in the hill country, those taken in the mountains being a great deal smaller than the first brood in the Save marshes, *e.g.*, it occurred in good condition at Jajce from June 25th to July 3rd, 1898, in the wet mountain meadows. Elwes notes it also at Jajcé, on July 26th, 1901; at Jezero, on June 25th-26th, 1901; at Serajevo, June 18th, 1899; at Slavonisch Brod, June 11th, 1901; and Dervent, June 12th, 1901. Miss Fountaine found it worn near Broussa at the end of August, and in early September 1903, certainly a second brood. Nicholson took it in June, 1892, finding it from June 9th-11th, near Budapest, *viz.*, in meadows at Budafok, about five or six miles below Budapest, and on the Adlersberg hill to the south of Buda, on June 14th, whilst, from ova obtained by a ♀ taken on the 11th, he reared three imagines on his return to England, a fine ♀ on August 9th, a small ♂ on the 14th, and another fine ♀ on the 17th, so that here the species is evidently double-brooded. Rühl notes it as occurring at the end of May and in July at Budapest. Miss Fountaine took the species in the forest of Szaàr, on June 5th, 1898, also a very small form commonly round Kavaran Szakul, in the third week of July; as well as near the Kammerwald, in early August, where most of the specimens were much larger, one would suppose a most unusual occurrence. Fleck says that the species is abundant in Roumania, the first brood flying in June, the second brood from about August 17th, on into October. Of the German localities the following may be noted :—In the beginning of August on the moorland marshes of East Prussia (Speiser); at the end of June, and in early July, in the marshes of the Oder, the ♀s in the Stepenitz district up to the end of July (Hering); a newly-emerged ♂ near Stralsund on June 15th, 1905 (Heckel); end of June until August, the ♀s about a fortnight later than the ♂s, in the Berlin district (Bartel and Herz); (Blachier has specimens taken here June 30th, 1901, by Bartel); end of June and throughout July, in Silesia (Döring); end of May and June, in Baden (Meess and Spuler); June 14th, 1901, going over, near Neu Breisach, in Baden (Lowe); a ♀ July 12th, 1859, near Worms (Glaser); in June, and again in August and September, in Alsace (Peyerimhoff). Gillmer doubts it being double-brooded in Alsace, but Giard says that it is double-brooded in the Somme district, the examples of the first brood large, and approaching *dispar*, the second brood smaller, as at Bordeaux; Bentall took it in the commencement of August, in the Jura, near Arlay. Rühl says that it occurs in July

and August on the Riviera; we know of no details. Menshootkin notes (*Ent.*, xxvii., p. 184) the capture of this butterfly near Louga, in the Govt. of St. Petersburg, on July 12th, 1892; the first example taken in the district. Further details are given *anteà*, pp. 434-439.

Habits.—On June 27th, 1906, two imagines were observed in the breeding-cage. The butterfly walks in a very stately manner, holding its wings erect, its body well off the ground, and its legs taking a firm grip of the leaf or other object on which it is moving; it has a peculiar way of pulling down one of the antennæ beneath one of the front legs, and combing it as if cleaning it. At rest, the body is held well above the resting-surface, the antennæ stretched out well in front, at about an angle of 45° to each other, either almost horizontally or slightly elevated, the wings raised at right angles to the surface on which the butterfly is standing, the inner margins of the hindwings folded round the body, forming, as it were, a sort of tube, in which the body rests. The forewings do not appear to be drawn down very far into the hindwings, a very fair portion of the costal area of the forewing, as well as the apex and considerable outer margin, being exhibited above the costal margin of the hindwing. The forewings, however, are much more completely hidden when the insect is asleep (Tutt). As Mr. Main most kindly sent me an imago which had emerged July 4th, 1906, I had three imagines, two of my own pupæ disclosing their imagines on July 1st and 6th respectively, which unfortunately were all females. These were kept alive as long as possible, in the vain hope of my being able to procure a male. Mr. Main's example died July 12th, having lived eight days. The other two, which fed more vigorously, lived nineteen days, dying on July 19th and 25th respectively. They were fed on sugar-water by means of an artist's brush. Though these three imagines were all from the same source, they showed very different dispositions, one of them being most docile, taking to the sugar-water readily, and sucking, on most days, steadily for five minutes, never showing any alarm. The second one had to be coaxed into feeding, and usually would only suck the brush for about half-a-minute at a time, and never seemed to be quite at ease as the first. The third one was wild, and could only with difficulty be induced to take any food. They took no notice of leaves or flowers that were placed in their cages, and they were generally to be found resting with closed wings on the top of their cages. On bright days, especially after feeding, they would spread out their beautiful wings and bask in the sunshine. Usually, they rested on all three pairs of legs, but occasionally they would use two pairs only, the front pair being drawn up near the body (Sich). Mrs. Nicholl says (*Ent. Rec.*, xi., p. 4) that "the insect, although not so large as the extinct English type, is a lovely butterfly. In the Save Marshes and around the glacis of the fortress of Slavisch Brod, it darts like a living flame among the tall greyish marsh-grass, then suddenly turning the grey underside of its wings towards you, it becomes almost impossible to mark its flight, till, with another turn, the fiery copper again flashes in the sunshine and tempts the reckless pursuer to flounder deeper and yet deeper into the bog. I think, on the whole, that the butterfly is easier to catch on a grey warm day without much sun. It may then be seen sitting with closed wings on blades of grass, or on yellow flowers, and may be quietly approached and boxed without difficulty." This reminds one of Bond's note that in the Cambridgeshire and Huntingdonshire fens, the imagines were very active

and shy, and would only fly when the sun shone; they would always settle on a thistle when they could find one in bloom, flying off to attack any insect, no matter what, that might come anywhere near them, not always returning, but generally passing on to another place. It was of very little use following them if you missed your first stroke with the net, as they went away like the wind, and seldom let you get a second chance; indeed, it was difficult to follow them, as keeping your eyes on them and the boggy places was rather a difficult job. Fleck says that, in Roumania, one finds the ♀s very abundant on flowers of thistle, and centaurea. The ♂s, he says, fly very rapidly and dart directly forwards, and do not often settle; they flap the wings together in flight; for the twinkle of an eye one sees the brilliant red of the upperside and then the insect suddenly disappears from sight. Peyerimhoff also notes that the species is very irregular in its appearance in Alsace, and states that for four years he had sought the species in vain, in localities where it was usually common, he observes it as most abundant in August, 1879, at Colmar. Rühl observes it as a species of irregular appearance, sometimes disappearing for years from localities where it has previously been abundant. Rehfous observes that, at Glanon-sur-Saône, *rutilus* flies only if it is warm and the sun shines, from 10 a.m. to 4.30 p.m.; when the sky is cloudy or it is windy, the insect disappears completely. Its flight, he says, is short, and it loves to settle, by preference, on flowers of *Lythrum salicaria*, the wings drawn up and closed; sometimes it opens them completely, and then glitters in the sun, so that it can be seen from a distance. Lowe observes that at Neu Breisach, he thought the species resembled *Heodes virgaureae* in flight and habit, and he considered the flight slow and the butterfly rather sluggish, the imagines basking on the broad leaves of the large water-dock. Aigner says that, in Hungary, it is specially fond of visiting ranunculus and scabious flowers.

HABITAT.—We have already quoted (*anteà* p. 423) Bree's note concerning the low marshy ground frequented by this species in the fen districts of this country, and his expressed surprise that the inundation of the locality during a great portion of the winter had no ill effects on the species, although large tracts of the country inhabited by it were completely under water. Godart observed that, in France, it inhabits marshy places, being very common in such localities near Compiègne and Villers-Cotterets, whilst Brown notes it as common in the marshes extending to the north and northwest of Bordeaux, etc. In the Somme district it occurs in peaty marshes (Giard), whilst in the dept. Aube it is very local in marshy fields (Jourdheuille), in the marshes of the dept. Aisne (Dubus), and of Bacalou near Bordeaux (Oberthür). Norris says that, in Piedmont, it occurs on the marshes round the great springs of Beinette, in the Pesio district; Verity notes it as occurring in the small marshes that extend along the coast of Tuscany, from Pisa nearly to Spezia, whilst Curò observes that it is not rare in fields in Piedmont. Mrs Nicholl records it as rather abundant in the marshes of the Save, near Bosnisch Brod, and around the glacis of the fortress of Slavisch Brod, and states that the insect is difficult to chase over the boggy ground of the marshes, but she also notes it as occurring in every wet valley of north Bosnia up to 2000ft. or more; she also found it in the marshes near Jajce, by the Pliva; and, in Bulgaria, in the marshes of the Struma valley. In Germany, Speyer says that it flies preferably in damp meadows, and seems

scarcely ever to extend beyond the hill region; in East Prussia it occurs in marshy meadows (Speiser); also in the Stepenitz district, as well as in the meadows of the Oder near Jungfernberg (Hering), in the marshy meadows of Silesia (Wocke), and of Baden (Meess and Spuler), in the marshy lowland meadows of Alsace (Speyer), whilst at Neu Breisach the ground it haunted was very wet (Lowe). Gillmer says that the butterfly flies in damp meadows, and prefers the ditches and watercourses; its appearance is very irregular, and it often disappears for a long time from districts where it has beforetimes been abundant. The comparative rarity of the insect in the Berlin district, he says, is perhaps to be explained by the fact that the foodplant is cut down in June and July, destroying thereby many eggs and larvæ; in quiet ditches, where the foodplant grows undisturbed, they are more abundant, and the larvæ and eggs may be found naturally in August. Bartel and Herz note the butterfly as being abundant in 1901, in the Berlin district, after having been comparatively rare for a long time. Peyerimhoff says that, in Alsace, it occurs in damp meadows and by the sides of ditches, *e.g.*, the ditches of the glacis at Strasburg, low places in the meadows between Hotzwihr and Massin-Ronga, the sides of the road in the forest of Niederwald, by the sides of ditches in the neighbourhood of Semland and Neuland, ditches near the Bruche, at Mutzenheim, etc. Miss Fountaine found it in the marshy meadows of the plain near Broussa, in September, 1903, always in the plain, where the wet meadows were irrigated by ditches. She adds that the moist meadows below the Kammerwald, where long grass, aquatic flowers and reeds flourish, form the best locality near Budapest. Stentz also records the insect as occurring on marshy meadows along the Eisack, in the Tyrol district. Fleck says that, in Roumania, the species flies everywhere in meadows, pastures, roadside ditches, etc., in numbers. Rehfous says that at Glanon-sur-Saône it flies by the pondsides and in marshy plains, and is never seen far therefrom. Young records it as occurring in north Persia, one specimen being taken at a height of above 9000ft. (*Ent.*, iii., p. 72).

[Localities.—Formerly locally abundant in a few places in the English fens, but long since extinct. The localities were—Cambridge (Haworth): near Ely (Skrimshire), Whittlesea Mere (Standish). Hunts (Lewin): Yaxley Mere (Standish), Holme Fen (Stretton), Trundle Mere (Dale). Norfolk: Bardolph Fen (Skrimshire *teste* Curtis). Suffolk: Benacre (*teste* Stephens).]

Distribution.—Local and rare in western Europe, extending into Mauretania. becoming commoner in the east and extending across the Palæarctic area to the Pacific. Italy, southeast Europe, Bithynia, Pontus, Armenia, Altai. [Africa—Algeria (Neuschild).] Asia: Asia Minor (Rebel), near Broussa (Fountaine), Armenia, Ladik, near Amasia (*teste* Rühl), Turkestan—Taschkend, Lepsa (Hormuzaki), Chanat Kokan (*teste* Rühl), eastern Asia—Amurland, Pokrofka (Graeser), Raddefka (Christoph), Askold, Bikin, Sutschan (Dorries), Corea—Chang-Do, south of Gensan (Leech), Pungtung (Herz), Kansou—Hè-Tchèn (Alphéraky), Kouldja (*teste* Rühl), Altai mountains (*teste* Blachier), South Altai—Kenderlik (Ruckbeil). Austria: Local and rare—Banat, Transsylvania (*teste* Rebel), Bohemia—near Zbirow (Speyer), Moravia—Bärn, Rottalowitz (Fritsch), Upper Austria—near Steyer rare (Brittinger), Lower Austria—Siegenfeld (*teste* Speyer), near Vienna, in the Hinterbrühl, Dornbacher district (Rossi), Heinstein district, the Grabenweg valley, in the Hals, local (Rogenhofer), Tyrol—Bozen, Trient (Mann), in the lowlands, rare—Brixen (Hinterwaldner), Carniola (*teste* Speyer), Dalmatia (Mann), Hungary—Szaàr, Kavaran Szakul, Kammerwald (Fountaine), Budapest, Budafok, the Adlersberg (Nicholson), Slavonia (Brit. Mus. Coll.), Hermannstadt (*teste* Rühl), Bucovina (Hormuzaki), Peszár, Szeged,

Nagyvárad, Parád, Pécs, Tapolcza, Nezsider, Pozsony, Tavarnok, Verebély, Nagymaros, N. Verücze, Rozsnyó, Eperjes, Szoroskö, Nagyszeben, Segesvár, Gyeke, Elöpatak, Nagyág, Mehádia, Fehértemplom, Vinkoveze, Lipik, Josipdol (Aigner). Bosnia and Hercegovina: From the lowlands of the Save Valley to the tree-covered mountains of central Bosnia, up to 900m. Save district—near Bosnisch-Brod, June 18th, 1898 (Nicholl), Dervent (Hilf), Jajcé, Jezero, end of June (Nicholl), Bosnatal, August, 1900 (Hilf), Fojnica, August 8th-September 10th, 1901 (Simonys), near Serajevo (Nicholl), Slavonisch Brod, Trebevic, Ivan, abundant (Apfelbeck), Baba Planina, near Gacko (Nicholl). Bulgaria and East Roumelia: West Bulgaria, near Bad Kostenec, September 5th (Rebel), Struma Valley, beginning of June (Mrs. Nicholl), Rosgrad—Danubian-Bulgaria, Markowitsch, etc. (*teste* Rebel). France: Somme district (Giard), Aube —Villechétif, Lusigny (Jourdheuille), Aisne—Rouvray, St. Quentin (Dubus), Gironde—Bordeaux (Brown), marshes of Bacalou (Oberthür), Doubs—between Pontarlier and St. Point, very rare (Bruand), Isère—Uriage (Oberthür), Jura—near Aulay (Bentall), Côte-d'Or—Glanon-sur-Saône (Rehfous), Haute-Marne—Langres in the Vosges (Miot), Oise—Compiègne, Villers-Cotterets (Godart), Seine—Petit-Gentilly (Godart), Meuse—Verdun (Kane). Germany: Prussia—very rare and only found in a few places in East Prussia, and not at all in West Prussia—Dantzig (*teste* Kane), Metgethen, Saalfeld, Osterode, Oletzko district, Lyck, Ortelsburg (Speiser), Pomerania rare—near Demmin, Negast (Paul and Plòtz), Stepenitz, on the Oder-meadows, near Jungfernberg, near Stettin (Hering), Stralsund (Heckel), Mecklenburg — Neustrelitz (Messing), Rüelow (Sponholz), Teterow (Gillmer), Stavenhagen (Tessmann), Brandenburg—near Berlin, rare—Finkenkrug, Schwanenkrug, Ludwigsfelde, Buch (Bartel and Herz), Spandau (Dadd), Province Saxony—near Magdeburg (Rühl), Posen, very rare—Owinsk, Wonsowo (Schumann), Silesia—near Koberwitz, Klarenkranst, Zesselwitz, etc. (Döring), Upper Lusatia, between Görlitz and Ostritz (Möschler), near Kritschen, Giersdorf, Seydorf (Wocke), Baden, in few places—Wassenweiller near Freiburg, rare (Postans), Dinglingen more frequent (Reutti), near Lahr, Mannheim, Weinheim (Meess and Spuler), Gottenheim (Nicholson), Würtemberg (*teste* Meess and Spuler), Hesse-Darmstadt—near Worms, July 12th, 1859, Lorsch, Lampertheim (Glaser), [Bavaria—Münich, Gern (Schrank),] Alsace—Neu Breisach (Lowe), Strasburg, Colmar, between Hotzwihr and Massin-Ronga, Niederwald, near Semland and Neuland, Matzenheim (Peyerimhoff), near Hüningen (Lippe), Lorraine—Metz, Münster (*teste* Kane). Greece: (Brit. Mus. Coll.). Italy: Milan (Turati), Pontine Marshes (*teste* Verity), Battaglia near Padua (*teste* Blachier), Sondrio district—Val Tellina (*teste* Kane), not rare in Piedmont, Modena district, many places (Curò), Beinette, in the Pesio district, Lago Massciuccoli, near Viareggio (Norris), Tuscany—coast districts between Pisa and Spezia (Verity). Roumania: Common — Grumazesti, near Tîrgu Neamtu, Bukarest (Caradja), Kloster Neamtz, Agapia, Peatra, Hango, Bacau, Slanic up to 900m., Jassy, Dulcesti (Fleck), Comanesti (Leon). Russia: St. Petersburg Govt.—Louga (Menshootkin), Wiatka district (Kroulikowsky), Transcaucasia—Lischk, Lagodekhi, Soukhoum—Kale, in May (Romanoff), Sarepta (Grum-Grshimailo), Caucasus (Bramson), Podolia, Bagovitza (Brit. Mus. Coll.). Servia: near Belgrade—Topciderpark (Lazarewitsch), Ak Palanka (Hilf). Switzerland: Canton Berne—Bernese Jura near Tramelan (Blachier).

## ERRATA.

Page 107, line 29.—For "our *A. lineola* ab. *suffusa*," read "our *A. lineola* ab. *brunnea*."

Page 129, line 7.—The record "Stratford-on-Avon" was corrected by Colbourne, *Entomologist*, vi., pp. 36-37.

Page 131, line 32.—For "Acromachus," read "Aeromachus."

Page 196, line 15.—For "ab. *esperi*, n. ab.," read "ab. *melicertes*, Schultz." We understand from Gillmer that Esper's figure had been previously named by Schultz; we have not seen his description.

Page 303, line 31.—For "*virgaurea*," read "*virgaureae*."

Page 306, line 23.—For "*dorylas*," read "*dorilis*."

Page 308, lines 40-42.—Place a ")" after "466," and place "(" before "*lampetie*," and ")" after "356-9."

Page 314, line 31.—For "form," read "former."

Page 320, line 35.—For "*Chrysophanus hippothoë* var. *gordius*," read "*Loweia alciphron* var. *gordius*."

Page 320, lines 37-38.—The egg of *Thestor ballus* here referred to is stated by Sich (*Ent. Rec.*, xviii., p. 239) to be most probably that of *Callophrys rubi*.
Page 355, line 10.—For "ab. *hübneri*, n. ab.," read "ab. *hübneri*, Obth., *Bull. Soc. Ent. France*, 1905, pp. 55-56."
Page 369, line, 18.—For "toward the base," read "toward the base of hindwing."
Page 392, line 3.—Perhaps "ragwort" is not so probable a mistake after all, for Harrison writes (*in litt.*, August 24th, 1906) that, on the sandhills at Burntisland, Fife, he found a colony of the larvæ of this species feeding on *Solidago virgaurea*.

# General Index to Parts I and II.

* Possibly Callophryid eggs, see *Ent. Rec.*, xviii., p. 239.

## Special Index to Part II.

* Denotes a synonym.

## ARRANGEMENT OF PLATES.—NOTICE TO BINDER.



* Probably an error for Callophryids (see *Ent. Rec.*, xviii., p. 239).

## NOTICE.

For issue of the second 20 parts, price 17s. 6d., payable in advance, see Advt. in the *Ent. Record*, no. 1, 1907 (Jan.).